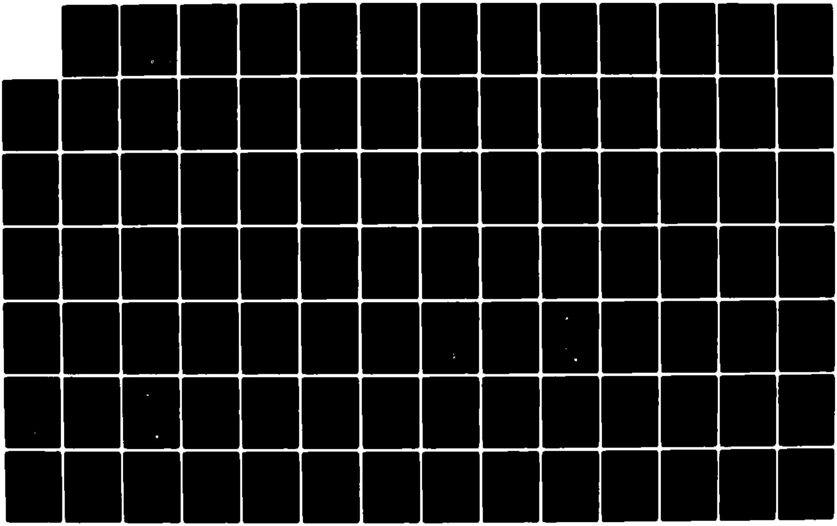
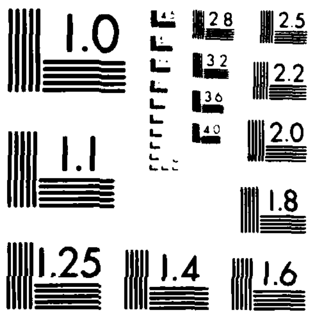
AD-A123 075 US COAST GUARD EQUIPMENT DEPLOYMENT REQUIREMENTS FOR HAZARDOUS CHEMICAL S..(U) TRANSPORTATION SYSTEMS CENTER CAMBRIDGE MA RESEARCH AND SPECI.. J BELLANTONI ET AL. 1/3

UNCLASSIFIED NOV 82 DOT-TSC-USCG-82-1 USCG-W-001-82 F/G 7/0 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

CG-W-001-82
DOT-TSC-USCG-82-1

U.S. Coast Guard Equipment Deployment Requirements for Hazardous Chemical Spill Response

Transportation Systems Center
Cambridge MA 02142

November 1982
Final Report

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

U.S. Department of Transportation
United States Coast Guard

Office of Marine Environment and Systems
Environmental Response Division
Washington DC 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CG-W-001-82	AD-A123 315	

4. Title and Subtitle
U.S. COAST GUARD EQUIPMENT DEPLOYMENT REQUIREMENTS FOR HAZARDOUS CHEMICAL SPILL RESPONSE

5. Report Date November 1982

6. Performing Organization Code DTS-53

7. Author(s) J. Bellantoni, L. Frenkel, I. Litant, P. Fang, J, Garlitz, F.Hafer, D. Mesnick

8. Performing Organization Report No. DOT-TSC-USCG-82-1

9. Performing Organization Name and Address
U.S. Department of Transportation
Research and Special Programs Administration
Transportation Systems Center
Cambridge, MA 02142

10. Work Unit No. (TRAIS) CG123/R2029

11. Contract or Grant No.

12. Sponsoring Agency Name and Address
U.S. Department of Transportation
United States Coast Guard
Office of Marine Environment and Systems
Washington DC 20590

13. Type of Report and Period Covered
Final Report
March 1980 - Sept. 1981

14. Sponsoring Agency Code GWEP-4

15. Supplementary Notes

16. Abstract

The objective of the study was to determine the types, quantities and locations of equipment required by the U.S. Coast Guard to respond to spills of hazardous chemicals into U.S. waters and adjacent shorelines, over and above the resources of private industry, contractors and other government agencies. The methodology was to (1) assess equipment availability outside the Coast Guard, (2) determine the distribution of hazardous chemical spills in time and location, and (3) determine the Coast Guard equipment deployment, allowing for the results of (1) and (2).

(1) It was found that strong response capabilities of specific types are available from EPA, DOD, local governments, industry groups and manufacturers. Because of the limited extent of the data it was not possible to establish a geographic distribution, but it was estimated that the national capability is about 59% commercial, 33% private and 8% governmental.

(2) It was found that historic chemical spill incidents cluster about industrial and population centers. Spills above a defined 'respondable' level were found to occur 40% in Central U.S., and 14%-26% in the East, Gulf and Western Coast areas

(3) Equipment for a 20-man response team was selected that can be fit into a single van, air-transportable by a Coast Guard C130 aircraft. A seven-site configuration with a total of 11 such vans was recommended as offering the best combination of response time and van availability.

17. Key Words
Hazardous Chemical, Response, Chemical Spill(s), U.S. Coast Guard, Hazardous Material(s), MTB, PIRS

18. Distribution Statement
DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	218	

PREFACE

This study of U.S. Coast Guard equipment deployment needed to respond to hazardous chemical spills in the United States was sponsored by the U.S. Coast Guard Office of Marine Environment and Systems, Marine Environmental Protection Division, and directed by the Pollution Response Branch G-WEP-4. The intent was to provide for hazardous chemical response a deployment analysis similar to that produced for oil spill response. The oil spill response deployment study[1] was a result of the U.S. Coast Guard's implementation of the Presidential Initiatives of March 1977.

The impetus for this study came in large part from the efforts of CDR J. L. Valenti, Chief of the Pollution Response Branch, GWEP-4. Assistance and guidance was provided throughout by Lt. M. Tobbe. Valuable contributions were made by many Coast Guard Personnel: Lt. Ron Weston, LCDR J. Paskowich, CDR D. Jensen, LCDR J. O'Beien, Ens. P. Fulton, Carlton Fowler, Lt. J. Gift, and others. Valuable and constructive comments were received from CDG R. Rufe, Jr. and Lt. D. Rome. Much assistance was received from private and industry sources, as well as from other government agencies. In particular, the assistance of Alan Humphries of the Environmental Protection Agency is acknowledged with thanks. Contributors within TSC included J. Cline, P. Hinchcliffe, D. O'Mathuna, W. MacLeod, T. Peters, and, especially, J. Garlitz.

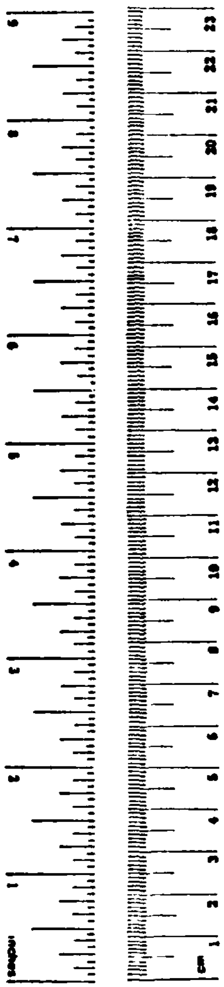
[1] "Deployment Requirements for U.S. Coast Guard Pollution Response Equipment," Rpt. No. CG-D-14-79; Vols. I and II, prepared for U.S. Department of Transportation, United States Coast Guard, by Transportation Systems Center, Cambridge MA, February 1979.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

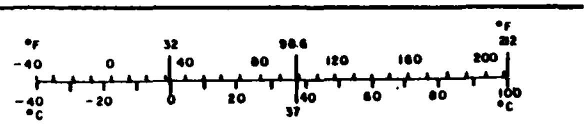


TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

The Federal Water Pollution Control Act, as amended 1972, and subsequent legislation and directives require the U.S. Coast Guard to provide men and equipment to respond to spills of oil and hazardous materials into U.S. coastal waters, the Great Lakes, ports and harbors, and adjoining shorelines.* Since the inception of the Coast Guard pollution response program more than ten years ago, the agency has acquired substantial experience in responding to oil spills. In addition, three specialized units, referred to as Strike Teams, have developed an inventory of sophisticated oil removal equipment to augment local resources when that is necessary. Response to chemical spills, however, is a more complex problem because of the large variety of chemicals shipped commercially. The proper selection and quantity of equipment, and its location, needs to be established before full augmentation of the Coast Guard chemical response capability may proceed. Recognizing this need for planning information, the Coast Guard requested that the Transportation Systems Center undertake a study to determine the types, locations and quantities of equipment they should deploy to meet the threat of hazardous chemical spills in the 1980 to 1990 decade. This deployment should take into account the existing response capabilities outside the Coast Guard, as well as the geographic distribution of hazardous chemical spills to be expected in that time frame.

*Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510) on 11 December 1980, subsequent to the initiation of the present project. This new statute broadens Coast Guard response authority in two significant ways: it provides jurisdiction for hazardous substance releases into environmental media other than surface waters (air, groundwater, land surface, tec.), and it increases by several times the number of hazardous substances for which the Federal government may initiate a removal operation. Although this project could not anticipate all the possible ramifications this increased responsibility will have on the Coast Guard response program (that will not be possible for some time), it does recognize all substances that are or may be considered hazardous under P.L. 96-510.

1.2 SCOPE

A previous study (Reference 1) has accomplished goals similar to those above for the Coast Guard's oil pollution response equipment. For that reason, the study was limited to hazardous materials other than oil.* Further, the broad category of "hazardous materials" was narrowed down by eliminating materials irrelevant to the Coast Guard's pollution response mission. The general categories excluded are summarized as follows:

(a) Non-flammable petroleum-based products. These materials require response equipment substantially different from those used for chemical spills. Oil spill response equipment requirements already have been derived for the Coast Guard (Reference 1), and are not covered in the present study.

(b) Materials that when spilled typically do not pose a significant threat to the environment or to the public health or welfare. These include such materials as coal, scrap rubber and batteries.

(c) Materials or types of releases that are normally dealt with by other agencies under other statutory authorities. These include sewage, solid waste, and radioactive materials.

(d) Non-specific but non-polluting materials. In many spills the material cannot be or is not identified and is reported as "other" or "unknown." These substances, as well as "natural substances" are distinct from "other hazardous chemicals" (which are included in the study). Because they do not call for response as hazardous chemicals, such materials have been excluded.

In order to obtain a specific set of "hazardous chemicals," the above exclusion rules were applied to two lists of materials: (1) the list of polluting substances contained in the Coast Guard Pollution Incident Reporting System (PIRS) coding manual (Reference 2), and (2) the list of hazardous

*Flammable petroleum products, while considered oils under the major statutes providing response authority, are included as hazardous materials here because they require the response techniques and equipment similar to those required for flammable hazardous chemicals.

substances designated by the Materials Transportation Bureau under the Hazardous Materials Transportation Act (1975). The full lists of materials included and excluded are given in Reference 3.

A second important limitation on the scope of the study is the restriction to the navigable waters and adjacent shorelines of the U.S. This designation of the Coast Guard's area of response stems from the Federal Water Pollution Control Act and amendments of 1972. Under the National Contingency Plan, the Coast Guard provides the On-Scene Coordinator (OSC) for coastal spills and the Environmental Protection Agency (EPA) for inland spills. The demarcation line between the two OSC jurisdictions is decided on a regional and district basis and usually is not published or available in coded form. As an approximation to this line, and to make it possible to process the large amounts of data available from the Materials Transportation Bureau, this study was limited to the counties adjacent to the U.S. coasts, Great Lakes, and major navigable waterways. These are shown in Figure A-1 (Appendix A). A list of these counties and the waterways to which they are adjacent is also given in Appendix A.

A third limitation on the scope of the study is the restriction to emergency spill situations. This excludes long term waste disposal site cleanup and chronic releases. Such non-emergency problems are usually handled by the EPA, by the spiller or by contractors. They do not normally require specialized Coast Guard equipment. The restriction to emergency response equipment excludes from consideration all long-term operations and devices such as filtration systems, incinerating equipment, earth-moving and stream-diversion equipment and large-scale removal, treatment or disposal systems.

1.3 METHODOLOGY

A three-step methodology was adopted for the project:

1. Assess the state of the art and the level of equipment availability outside the Coast Guard for hazardous chemical response.

2. Determine the frequency and geographic distribution of hazardous chemical spills in the past and to be expected in the future.

3. Determine the types, quantities and locations of U.S. Coast Guard response equipment needed to meet the projected chemical spill threat, allowing for the availability of equipment from non-Coast Guard sources from (1) and the spill threat from (2).

The first step in the methodology was undertaken by an informal survey, carried out by telephone interviews, visits, and letters, of government agencies, commercial contractors, and private spill control organizations (Reference 4). While an exhaustive survey could not be undertaken, it was expected that the general level of preparedness could be ascertained with regard to the major items of chemical response equipment.

The second step consisted of a computer analysis of two historic spill data bases: the Coast Guard's Pollution Incident Reporting System (PIRS) and the Materials Transportation Bureau's Hazardous Materials Incident Reports (HMIR). Records were extracted from these data bases spanning the period 1971 through 1979. Incidents that did not occur within one of the counties of interest, or that did not involve one or more of the selected hazardous chemicals, as described under SCOPE above, were discarded. The remaining 38,000 records were analyzed for geographic distribution, and for trends in time. The results were employed to project the hazardous chemical spill threat throughout the continental U.S. to 1985. The second step is reported in Reference 5.

The third activity was approached in a four step process. First, the types of equipment suitable for Coast Guard response units were inferred from the qualitative survey of step one and from consultation with experienced response personnel. Next, several configurations of base locations were postulated for the equipment, and mean response times calculated for each configuration. Then, the number of response units was deduced that would have to be stationed at each base in order to provide coverage for multiple spills with 95 percent probability. From the total number of units and the response time for each configuration, judgements were then made as to the preferred base configuration.

1.4 STRUCTURE OF THE REPORT

Section 2 outlines the major results of the first step of the methodology, i.e., the assessment of the state-of-the-art and level of equipment availability outside of the Coast Guard.

Section 3 reviews the results of the second step, i.e., the geographic and temporal distribution of hazardous chemical spills in the U.S. A list of counties with the highest frequency of spills is included.

Sections 4 and 5 carry out the last step of the methodology. Section 4 discusses the present Coast Guard chemical response capability and recommends types of equipment to complement the non-Coast Guard capability in the U.S. In Section 5, response times are calculated, based on the trial base configurations and the spill locations of step 2. Total numbers of response units are calculated for each configuration, and approximate costs estimated, assuming each response unit is composed of the equipments deduced from step 1.

Section 6 contains the conclusions and recommendations from the study.

2. ASSESSMENT OF NON-COAST GUARD HAZARDOUS CHEMICAL RESPONSE CAPABILITIES

The objective of the first part of the study was to estimate the quantity and types of equipment available outside the Coast Guard to respond to actual or threatened spills of hazardous chemicals. The ability of the private sector, including cleanup contractors, railroads, and chemical manufacturers, as well as agencies of the Federal, State and local Governments was to be reviewed.

A complete or nearly complete inventory of currently available equipment was not possible within the project because of resource limitations. In addition, no judgments were made as to whether or not the custodians of the equipment surveyed had conducted the training necessary to use the equipment properly or as to whether the equipment was maintained in good condition. Nevertheless, general qualitative information was obtained from a limited survey. The scope of the task was limited to certain equipments of interest in the initial response to a spill:

- Personnel protection
- Environmental monitoring
- Emergency containment
- Rupture-puncture plugging and repair
- Offloading-transfer
- Communications
- Logistics

Specifically excluded were major items used in the longer-term containment and cleanup of a spill:

- Neutralizers
- Filtration systems
- Incinerators
- Earth moving equipment
- Stream diversionary devices
- Removal, treatment, or disposal systems

In addition, equipment for handling spills of petroleum products was excluded from the study for the reasons given in the Introduction of this report. Thus, this task dealt almost exclusively with equipment suitable for response to spills of hazardous chemicals. The chemicals considered to be hazardous are those described in the Introduction and given in Reference 3.

The study area included all 50 of the United States, plus Puerto Rico and the Virgin Islands. Emphasis was placed on those counties which are adjacent to the U.S. navigable waters, as described in the Introduction and Appendix A. These are referred to as the "counties of interest." Information obtained from entities located within the counties of interest is listed in the first part of Appendix A, Reference 4, while information from entities located outside the counties of interest is listed in the second part of that Appendix.

Data were also obtained on the capabilities and roles played by many organizations, including fire and police departments, local, state and federal agencies, chemical manufacturers, and the military services.

2.1 METHODOLOGY

The equipment information was obtained primarily through telephone interviews, was supplemented by visits, and literature. Assistance was also requested by letter from trade organizations, so that resource information could be obtained from their membership. A list of the names, addresses and telephone numbers of over 100 organizations and persons contacted is given in Reference 4. These include the Department of Defense, state governments, independent authorities and commissions, police and fire departments of cities, private contractors, trade associations, and chemical manufacturers. Synopses of the information gathered from these sources are given in Appendix B.

As the study progressed, certain limitations inherent in the methodology became apparent:

- The individual entities holding equipment are too numerous to interview fully.

- Some of the entities contacted gave limited information concerning their capability.
- The equipment is frequently kept at central locations but can be deployed rapidly over a wide geographical area; attributing such equipment to the central location can be misleading.
- Much of the equipment used for spill response is multi-purpose i.e., it is normally used in the transportation, storage, and handling of chemicals, or it can also be used for response to petroleum spills.
- Large quantities of equipment are not available to the Coast Guard for response to all spills, but could be made available under specific situations. Examples are equipment stocked by chemical manufacturers, railroads, or military services.

The first of these limitations is serious. It cannot be overcome except by a full national inventory of equipment, a procedure not only requiring resources beyond the present project, but also contingent on approval of the Office of Management and Budget for the requisite survey. However, a national inventory of equipment available for hazardous material spills (SKIM) is maintained by the Coast Guard. While this listing had proven useful in locating oil spill response equipment, it was not known at the start of the study how complete a listing it provides of chemical spill clean up equipment. Accordingly, the approach taken was to extract such data from the SKIM list and to integrate it into the present assessment.

2.2 INTEGRATION OF INTERVIEW DATA AND SKIM LIST

Combining the SKIM listings and the results of the interview data presented several difficulties: the amount of relevant chemical response gear in SKIM was expected to be small; the SKIM list for the entire country is not practical to retrieve; matching of items was difficult because of differences in the data items of the two lists. Accordingly, the comparison was approached cautiously, in three steps.

As a first step, copies were obtained of the SKIM Lists for the Marine Safety Office (MSO) Boston, for the Third Coast Guard District, and for the Atlantic Strike Team. From these lists, it was seen that, although the

inventory of petroleum-related response equipment was extensive, it was weak in listing and or identifying equipment needed for responding to chemical spills. For example, the SKIM Lists contained many entries of vacuum trucks, but these entries did not indicate which trucks had a chemical-handling capability; that is, which trucks were made of stainless steel or lined with teflon, polyethylene or glass. Accordingly, the project was amended to concentrate effort on obtaining inventory data for equipment specifically needed to respond to chemical spills.

As the next step, therefore, a copy of the nationwide SKIM List was obtained from Coast Guard Headquarters (G-WER-4) for three kinds of chemical spill response equipment. These were: Code 19, Safety Equipment and Special Clothing; Code 22, Chemical Agents; and Code 25, Equipment for Scientific Analysis. These three lists were compared with the results of the telephone inventory. It was determined that:

1. Chemical Agents on the list were all dispersants, neutralizers, or solvents used in spill cleanup, and thus fell outside the areas of interest of this inventory study. This list contained eleven entries. No use was made of this list.

2. Equipment for Scientific Analysis provided a list of major analytical equipment, with only one item of the 29 on the list being cited as mobile. Most of the items were chemical laboratory devices unsuited for field use. Depending on the type of equipment and the type of test, production rates ranged from as high as six samples per hour to as low as eight samples per day. However, set-up time would substantially affect the utility of the equipment. The time between the actual spill occurrence and the receipt of analysis results is the sum of the time needed to obtain a sample of the spilled material and get it to the laboratory, set up and perform the analysis, and get the results back to the spill site or the On-Scene Coordinator (OSC). Since this spill-to-identification time is often several hours or days, the laboratory analytical equipment is useful in determining the pace and effectiveness of long term cleanup operations, but is of limited use in the planning and execution of early-response

activities. Some of the analytical items on the SKIM List and the study list were the same, but there were also many differences. Because of these differences and because of the small numbers of items listed, it was not possible to develop a reliable estimate of the total population of analytical equipment available. The SKIM List had no entries for the Boston MSO.

3. The SKIM Safety Equipment and Special Clothing list was not as comprehensive as the results of interviews for those regions where a major effort was made to contact the principal spill response agencies. In addition, where the same organization was cited on both lists, the items and quantities frequently differed. These differences could have arisen because the equipment lists were obtained at different times and from different people. The SKIM data were combined with the study data to provide a total list of equipment. Where quantities differed, the larger quantity was used.

As a final step, a comparison was made between the SKIM List and the study inventory for the First District. An effort was made to obtain a large data sample for this District, and most large response organizations were contacted, as well as many smaller ones. The results are shown in Table 2-1. Total numbers of equipment are shown as obtained from the two sources. The totals are the sum of the two numbers adjusted to prevent double counting (four agencies appeared on both lists). Overlap is those quantities which appear on both lists and which would cause double counting if the two lists were simply added. The SKIM to Total (S/T) percentage was calculated; it shows that the SKIM List is rather incomplete with regard to personnel protection equipment.

Similar calculations were not made for field meters and laboratory equipment because the numbers are too small to yield meaningful results. Despite the difficulties involved, the SKIM data were integrated into the overall assessment, and contributed a small but discernable amount to the quantitative results.

TABLE 2-1. PERSONNEL PROTECTION EQUIPMENT, SKIM LIST/ STUDY LIST COMPARISON, FIRST DISTRICT

	SKIM LIST	STUDY LIST	OVER-LAP*	TOTAL**	S/T,*** PERCENT
Protective Clothing					
Unknown	0	0	0	0	-
Standard Rubber Suits	0	207	0	207	0
Fire Suits	10	84	6	88	11
Acid Suits	4	28	4	28	14
Fire/Chemical Suits	0	0	0	0	-
Breathing Apparatus					
Unknown	2	0	0	2	100
Self-Contained	8	70	8	70	11
External Supply	0	19	0	19	0
Gas Masks	0	39	0	39	0
Totals	24	447	18	453	5

*Quantities which appear on both lists.

**All total numbers have been adjusted to prevent double counting; SKIM List plus Study List minum OVERLAP equals TOTAL.

***SKIM LIST/TOTAL

2.3 QUANTITATIVE RESULTS

2.3.1 Tabulation of Data

After the data collection effort was completed, the quantities of equipment for both the study lists and the SKIM List were entered into data sheets. (See Appendix A of Reference 4.) The data are summarized in Tables 2-2, 2-3, 2-4, and 2-5. Table 2-2 shows the quantities of protective clothing, breathing apparatus, field analytical meters, and laboratory analysis items, by each Coast Guard District, within the counties of interest as defined in Appendix A. Table 2-3 shows the same information, by state, for those agencies located outside of the counties of interest. Both tables also show the grand totals. The equipment totals by Coast Guard District for off-loading equipment are shown in Table 2-4 for the counties of interest and in Table 2-5 for outside those counties.

The quantity data seen in Table 2-2 for personnel protection equipment do not show any obvious pattern. The large quantities shown for the First and Third Districts are due to the special emphasis placed on obtaining a large data sample in those Districts. The quantities for the Second District are also large; this is probably due to the large geographical area included in the Second District (central U.S. including the Mississippi and Ohio River Valley) and to the large number of chemical industries located there.

The off-loading equipment, Tables 2-4 and 2-5, does not include the SKIM List data. The large amount of SKIM List data made entering it impractical. Further, the SKIM List does not identify the material of which the off-loading equipment is constructed. Thus all entries would have been in the Unknown Material class. Since this study was concerned with chemicalcompatible equipment, large numbers of equipment of unknown material would not have contributed to the end result of the project.

The offloading equipment data, Tables 2-4 and 2-5, show that the industry is still heavily petroleum oriented. Only 37 percent of the listed pumps are made of chemical-resistant materials. Similarly, only 20 percent of the vacuum trucks and 15 percent of the tank trucks are chemical-resistant.

TABLE 2-2. PERSONNEL PROTECTION EQUIPMENT AND ANALYTICAL EQUIPMENT QUANTITIES WITHIN COUNTIES OF INTEREST

EQUIPMENT ITEM	CODE*	COAST GUARD DISTRICT 1	2	3	5	7	8	9	11	12	13	17	TOTAL	TABLE 6-2	GRAND TOTAL
Protective Clothing:															
Unknown	0	0	24	322	0	0	17	0	0	0	0	0	363	20	383
Standard Rubber Suits	1	207	50	444	20	6	170	164	60	198	240	50	1,609	278	1,887
Fire Suits	2	88	19	63	3	10	35	78	20	10	4	0	330	204	534
Acid Suits	3	28	83	37	72	3	158	53	32	26	28	40	560	546	1,106
Fire/Chemical Suits	4	0	1	0	1	0	2	0	1	0	0	0	5	0	5
Breat ing Aparatus:															
Unknown	0	2	227	0	12	7	0	30	58	17	2	0	355	6	361
Self-Contained Systems	1	70	66	126	62	25	1,136	227	33	33	51	42	1,871	522	2,393
External Supply Systems	2	19	18	57	13	3	8	10	34	4	4	0	170	76	246
Gas Masks	3	39	146	49	25	17	85	30	4	4	17	0	416	125	541
Field Analytical Meters:															
Unknown	0	0	6	11	4	0	2	0	1	11	1	0	36	29	65
pH Meters	1	2	20	13	18	0	10	1	2	1	0	0	67	48	115
Explosimeters	2	11	14	55	29	0	11	10	17	10	15	1	173	95	268
Multiple Gas Samplers	3	2	5	10	5	0	1	3	1	1	17	0	45	37	82
Oxygen Samplers	4	4	11	21	4	0	9	2	2	2	5	0	60	52	112
Hydrogen Sul. Samplers	5	1	0	0	0	0	0	0	0	0	0	0	1	3	4
Laboratory Analytical Items:															
Unknown	0	0	2	2	3	0	1	0	0	0	0	0	8	7	15
Gas Chromatographs	1	0	2	9	1	0	17	1	2	1	0	0	33	21	54
Mass Spectrometers	2	0	2	0	2	0	0	1	0	0	0	0	5	7	21
Infra-red Spectrometers	3	0	8	4	0	0	5	0	2	1	0	0	20	15	35

*Type of Equipment Code; see Reference 4., Appendix A for complete definitions.

TABLE 2-3. PERSONNEL PROTECTION EQUIPMENT AND ANALYTICAL EQUIPMENT QUANTITIES OUTSIDE OF COUNTIES OF INTEREST

	Protective Clothing					Breathing Apparatus				Field Meters						Analytical Equipment			
Code*	0	1	2	3	4	0	1	2	3	0	1	2	3	4	5	0	1	2	3
Arizona		6		4			4	4	4	1			1						
California		12	15	23			11	8	8	2	1	1	2	1			1	1	1
Colorado		6		4			4	4	4		1		1						
Florida		2	2	4			2					1		1					
Georgia		3		6			6		6			10	10						
Idaho		6		4			4	4	4	1			1	1					
Illinois			10	10			2				1	1		1					
Kansas			10	10			3				2	2		2			2		2
Louisiana		6		4			4	4	4	1			1	1					
Massachusetts	8	20	17	36			86		48		3	3	5	4		1	2		1
Michigan				19		6	3	2			2			3			2	3	
Minnesota		6		4			4	4	4	1			1	1					
Missouri				1															
Montana		12		8			38	8	8	5		3	2	2	3				
Nebraska		6	5	9			6	4	4	1	1	1	1	2			1		1
New Jersey			35	35			6				3	3		3			3		2
New Mexico		6		4			4	4	4	1			1						
New York		100		5			5												
North Carolina			10	60			7	1	4	4	2		3	1		2	3	1	3
Ohio			35	212			262			1	12	44	2	5			2	1	1
Oklahoma		10		9			6	4	4	1	1		1	1		2			

*Type of Equipment Code; see Table 2-2.

TABLE 2-3. PERSONNEL PROTECTION EQUIPMENT AND ANALYTICAL EQUIPMENT QUANTITIES OUTSIDE OF COUNTIES OF INTEREST (Cont.)

	Protective Clothing					Breathing Apparatus				Field Meters						Analytical Equipment			
Code*	0	1	2	3	4	0	1	2	3	0	1	2	3	4	5	0	1	2	3
Oregon	12	6		4			16	4	4	1		1	1	1					
Pennsylvania			40	40			6				3	3		5			2	1	2
South Carolina		7		4			8		3	2		3				2	2		1
Tennessee		4		4			4			2		2							
Texas		8	5	11			8	4	4	2	1	2	1	1			1		1
Utah		6		4			4	4	4	1			1	1					
Vermont								5											
Virginia											15	15		15					
Washington							1												
Wyoming		12		8			8	8	8	2			2						
TOTAL	20	278	204	546	0	6	522	76	125	29	48	95	37	52	3	7	21	7	15
Table 2-2	363	1609	330	560	5	355	1871	170	416	36	67	173	45	60	1	8	33	5	20
GRAND TOTAL	383	1887	534	1106	5	361	2393	246	541	65	115	268	82	112	4	15	54	12	35

*Type of Equipment Code; see Table 2-2.

TABLE 2-4. OFF-LOADING EQUIPMENT TOTALS BY COAST GUARD DISTRICT WITHIN COUNTIES OF INTEREST

EQUIPMENT ITEM	COAST GUARD DISTRICT 1	2	3	5	7	8	9	11	12	13	17	TOTAL	PERCENT OF TOTAL
Pumps													
Unknown	10	0	25	11	0	4	2	1	0	1	0	54	18
Steel	2	15	42	32	0	19	20	2	2	2	0	136	45
Stainless Steel	0	2	5	20	5	7	4	5	5	1	0	54	18
Rubber Lined	0	0	0	0	0	2	0	0	0	0	0	2	1
Plastic Lined	0	4	35	0	0	8	0	2	2	2	0	53	18
Vacuum Trucks													
Unknown	31	0	5	0	0	1	0	0	0	0	0	37	34
Steel	0	3	25	6	0	0	14	2	0	1	0	51	46
Stainless Steel	0	0	12	0	0	2	0	0	0	0	0	14	13
Rubber Lined	0	0	1	0	2	0	0	0	0	0	0	3	3
Plastic Lined	0	0	1	0	0	0	0	0	0	0	0	1	1
Glass Lined	3	0	1	0	0	0	0	0	0	0	0	4	3
Tank Trucks													
Unknown	27	3	4	3	0	5	0	0	0	0	0	42	37
Steel	0	0	6	10	0	39	0	0	0	0	0	55	48
Stainless Steel	0	0	1	0	0	0	3	0	0	0	0	4	3
Rubber Lined	0	0	0	0	0	2	12	0	0	0	0	14	12
Plastic Lined	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Lined	0	0	0	0	0	0	0	0	0	0	0	0	0
Vacuum Tank Barges													
Unknown	2	0	0	0	0	[illegible]	0	0	0	0	0	2	67
Steel	0	0	0	0	0	[illegible]	1	0	0	0	0	1	33
Plastic Lined	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Glass Lined	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2-4. OFF-LOADING EQUIPMENT TOTALS BY COAST GUARD DISTRICT WITHIN COUNTIES OF INTEREST (Cont.)

EQUIPMENT ITEM	COAST GUARD DISTRICT 1	2	3	5	7	8	9	11	12	13	17	TOTAL	PERCENT OF TOTAL
Vacuum Tank, Skid Mtd.													
Unknown	4	0	4	0	0	0	0	0	0	0	0	8	62
Steel	0	0	0	2	0	0	2	0	0	1	0	5	38
Plastic Lined	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass Lined	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2-5. OFFLOADING EQUIPMENT OUTSIDE OF COUNTRIES OF INTEREST

CODE*	PUMPS					VACUUM TRUCK						TANK TRUCK						VACUUM BARGE				VACUUM TANK SKID MTD.				DRUMS		
	0	1	2	3	4	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	0	1	2	3	0	1	2
ARIZONA		2	1		2																							
CALIFORNIA		4	2																									
COLORADO		2	1		2																							
FLORIDA																										2		
GEORGIA																												
IDAHO																												
ILLINOIS																												
KANSAS																												
LOUISIANA		2	1		2																							
MASSACHUSETTS		3											2															
MICHIGAN																												
MINNESOTA		2	1		1																							
MISSOURI																												
MONTANA		4	2		4																							
NEBRASKA		2	1		2																							
NEW JERSEY																												
NEW MEXICO		2	1																									
NEW YORK							2	1																				

TABLE 2-5. OFFLOADING EQUIPMENT OUTSIDE OF COUNTRIES OF INTEREST (Cont.)

	PUMPS					VACUUM TRUCK						TANK TRUCK						VACUUM BARGE				VACUUM TANK SKID MTD.				DRUMS		
CODE*	0	1	2	3	4	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	0	1	2	3	0	1	2
NORTH CAROLINA		3												6	3													
OHIO			14				2						2										10					
OKLAHOMA		2	4		2																							
OREGON		2	1		2																							
PENNSYLVANIA								2025				625	301		150													
SOUTH CAROLINA																												
TENNESSEE																												
TEXAS		2	1		2																							
UTAH		2	1		2																							
VERMONT																												
VIRGINIA		3																										
WASHINGTON																												
WYOMING		4	2		4																							
TOTAL		41	33		25		4	2026				625	303	8	153								10			2		
TABLE 2-4	54	136	54	2	53	37	51	14	3	1	4	42	55	4	14	0	0	2	1	0	0	8	5	0	0	0	0	0
GRAND TOTAL	54	177	87	2	78	37	55	2040	3	1	4	667	358	12	167	0	0	2	1	0	0	8	15	0	0	2	0	0

*Type of Equipment Code; see Table 2-2

It should be noted that many of the larger cleanup contractors have standby or on-call contracts with chemical trucking companies, such as Chemical Leaman, Inc. or Matlack, Inc., whereby they can quickly obtain the necessary equipment.

Table 2-6 shows how the survey results are distributed among Federal Government, Local and State Government, Commercial, and Private organizations. About 59 percent of the equipments tabulated were in commercial contractor facilities, about 33 percent in private facilities. Government equipment (Federal, State and Local) was about 8 percent, including Coast Guard units.

2.3.2 National Total Estimates

The data tabulated in Tables 2-2, 2-3, 2-4 and 2-5, are necessarily incomplete. To assess the national capability, it is necessary to make an estimate of the actual totals of equipment of each type that are available in the Coast Guard Districts throughout the country. Preparing an estimate of total equipment available proved to be difficult, even for those selected areas where a comprehensive inventory effort was made. First, the sample data were not completely reliable. Quantities often differed between the study list and the SKIM List. Also, some contractors were expanding their chemical capability and were increasing and/or expanding their equipment lists. Second, some of the agencies contacted did not provide the requested information. Third, it was not possible to identify all agencies that had a chemical response capability. Fourth, equipment might not always be available to the Coast Guard. Chemical manufacturing plants were usually well equipped, but their equipment (and trained manpower) was usually available only for spills of their own chemicals.

For the above reasons, the sample is incomplete, and the relationship of the sample to the total equipment population is unclear; thus, the estimated equipment listing does not give a precise picture of overall chemical spill response capability. However, crude estimates of equipment availability, based on the best judgement of those who carried out the interviews and surveys, were made for use in the follow-on phases of the program. The completeness of the data was estimated to be as follows:

TABLE 2-6: DISTRIBUTION OF UNITS OF EQUIPMENT BY ORGANIZATION TYPE AS TABULATED IN REFERENCE 4.

Number of Units	702	473	8200	4570
Percent of all units	5%	3%	59%	33%
Number of locations	25	14	101	130
Units per location	28	34	81	35

First District. A major effort was made to obtain a large data sample. The total listing (SKIM List plus Study List) is probably about two thirds of the total available equipment.

Third District. A strong effort was made to obtain a representative data sample. The total listing is probably about one half of the available equipment.

All other Districts. A reasonable sample was sought. The total listing is probably no greater than one third of the available equipment.

In order to obtain a conservative (low) estimate of actual equipment available, the above fractions were increased to 80 percent, 70 percent, and 50 percent, respectively. The corresponding amplification factors, to be applied to the survey data in order to obtain total equipment estimates, are 1.25, 1.43 and 2.0. The results are shown in Table 2-7. This table was obtained by applying the amplification factors for the several districts to the data of Tables 2-2, 2-3, 2-4 and 2-5, and adding the results for each equipment group.

The accuracy of Table 2-7 is poor. The lower limit to the error is -50 percent (based on the 2.0 amplification factor) but the upper limit cannot be estimated as accurately. Because most of the major cooperatives and contractors have been surveyed. The total remaining inventory probably does not exceed the amounts covered. This gives a nominal upper limit on the error of 100 percent. Thus the error limits to Table 2-7 are estimated as -50 percent, +100 percent.

2.4 QUALITATIVE RESULTS

Some qualitative results emerge from the interview and survey data, when combined with the SKIM information. Appendix B shows that:

(1) EPA strongest capability is in technical advice and detection and identification equipment.

TABLE 2-7: ESTIMATED TOTAL NUMBER AVAILABLE IN U.S. OF SELECTED CHEMICAL SPILL RESPONSE EQUIPMENT

	Coastal and Waterway Counties	Total United States*
Fire, Chemical, or Acid Units	1650	3050
Other Suits	3350	3900
Breathing Apparatis	5400	6750
Field Instruments	690	1200
Laboratory Instruments	120	220
Chemical Compatible Pumps	195	315
Other Pumps	330	410
Chemical Compatible Vacuum Trucks	30	4080
Other Vacuum Trucks	135	140
Chemical Compatible Tank Trucks, Barges and Tanks	35	360
Other Tank Trucks, Barges and Tanks.	190	2050

* except Alaska and Hawaii.

(2) DOD has substantial equipment at its various bases for response to fire, Nuclear/Bacterological/Chemical (NBC) releases, for fuel handling, and explosion control.

(3) Local governments and authorities are well equipped for fire and communications, but little else.

(4) Many commercial contractors maintain mobile units with chemical suits, gas masks, self-contained breathing apparatus, and pumps, bladders and trucks. Mobile labs and communication equipment are also common.

(5) The Chlorine Emergency Plan, CHLOREP, operated by the Chlorine Institute maintains 64 response teams in the U.S., each with 24 hour coverage. Their capabilities include plugging and patching. The National Agricultural Chemicals Association (NACA) has 40 Pesticide Emergency Teams throughout the country. Mutual assistance programs also exist for vinyl chloride and hydrogen cyanide.

(6) Chemical manufacturers commonly equip their plants for response on-site. Most large chemical shippers also maintain emergency trailers to respond to spills of their products. They commonly contain chemical/acid suits, meters, breathing apparatus, tool kits, meters, and in some cases pumps, overpack drums, and tank trucks.

(7) Most railroads maintain one or more equipment storage sites along their line. They stock rubber suits, hoods, goggles, boots, and breathing apparatus. Offloading equipment is not common (exceptions: Southern Railroad, Boston and Maine).

The seven results just stated are displayed graphically in Figure 2-1. From this Figure:

(8) The <u>most</u> <u>general</u> <u>available</u> capability is lodged with commercial contractors.

	SOME CAPABILITY DETECTED IN SURVEY
	RELATIVELY GOOD CAPABILITY DETECTED IN SURVEY
	NO CAPABILITY RECORDED IN SURVEY
C	CAPABILITY LIMITED TO CHLORINE SPILLS
R	CAPABILITY LIMITED TO RAILROAD SPILLS
P	CAPABILITY LIMITED TO PRODUCT SPILLS OF MANUFACTURER

FIGURE 2-1. QUALITATIVE DISPLAY OF NON-USCG HAZARDOUS CHEMICAL RESPONSE EQUIPMENT CAPABILITY

	EPA	US AF	US ARMY	US NAVY	DOE	STATE AGNCY	LOCAL AUTH.	CITY POL.	CITY FIRE	PVT CONTR.	CHEM TREC	CHLO REP	AAR	CHEM. MANU	R.R.	PVT LABS
TECHNICAL ADVICE													R	P		
COMMUNICATIONS																
FIELD INSTRUMENTS														P	R	
LABORATORY ANALYSIS														P	R	
FACE & GAS MASKS												C		P	R	
SELF-CONTAINED BREATHING APPARATUS												C		P	R	
PROTECTIVE CLOTHING												C		P	R	
FIRE SUITS														P		
CHEMICAL/ACID SUITS														P		
FOAMING CAPABILITY																
OFFLOADING & CHEMICAL PUMPS														P		
CHEMICAL TANKS AND VANS, TRUCKS																
PLUGGING AND PATCHING EQUIPMENT												C				
CHEMICAL OVERPACK DRUMS														P		

FIGURE 2-1. QUALITATIVE DISPLAY OF NON-USCG HAZARDOUS CHEMICAL RESPONSE EQUIPMENT CAPABILITY (Continued)

(9) Good capability for response to a spill of a specific chemical can often be provided by the chemical manufacturer, or by one of the product associations such as CHLOREP.

(10) Except for specific products, such as chlorine, the least common capabilities are those for

- chemical pumps for offloading
- tanks, vans and trucks for chemicals
- plugging and patching equipment
- chemical overpack drums

Further qualitative results are obtained from Tables 2-2 through 2-5, (subject to the error limits discussed in Section 2.3):

(11) Over half of the available personnel protective gear and instrumentation is in the coastal and waterway counties.

(12) Chemical-compatible offloading and storage equipment, such as vacuum trucks and tanks, is available in large quantity from a few commercial firms, such as Chemical Leaman, Inc. and Matlack, Inc.

(13) The SKIM analytic equipment entries generally do not show them as mobile.

(14) The SKIM entries for hazardous chemical response equipment are approximately 25 percent of the total study survey listing of Reference 4, Appendix A.

(15) The overall accuracy of the estimated national capability is about -50 percent, +100 percent.

(16) Based on an examination of first District data, the SKIM List contains about 5 percent of the total amount of protective clothing and breathing apparatus found in the combined interview and SKIM list.

2.5 CONCLUSIONS

From the above results the following conclusions are drawn:

First, because the assessment is not based on a comprehensive survey the potential for low estimation is greater than that for over estimation. Accordingly results showing large numbers of equipment (strong capability) are more reliable than those showing small numbers. In the strong capability category, are results (1), (2), (3), (5), (9), (12).

Second, the inaccuracy of the assessment, particularly outside of the first and third Districts, makes it difficult to ascribe a geographic distribution to the capabilities.

Third, samples of the SKIM Listing show that it is weak in chemical response gear, and especially deficient in personnel protective gear.

Fourth, the distribution of national capability is approximately 59 percent with commercial contractors, 33 percent with private organizations, and 8 percent with Federal, State and local agencies.

3. DISTRIBUTION OF HAZARDOUS CHEMICAL SPILLS IN THE U.S.

This Section describes the results of the data gathering and analysis performed to complete the second of the three steps in the methodology described in Section 1. It covers the geographic distribution of historic hazardous chemical (hazchem) spills as extracted from three sources:

(1) The Hazardous Materials Information Report (HMIR) file of the Materials Transportation Bureau (MTB).

(2) The Pollution Incident Reporting System (PIRS) of the Coast Guard.

(3) The Pipeline Carrier Accident Report (PCAR) file, obtained from the Office of Pipeline Safety of the MTB.

The three sources differ in their origins and purposes. The first two, the HMIR and the PIRS files, far outweight the third in volume of data and warrant some discussion.

The HMIR data have been submitted by carriers in accordance with 49 CFR 171.15 and 171.16 since 1970. This statute requires reports on Form DOT F 5800.1 of hazardous materials spills resulting in death, injury and damage over $50,000. Bulk shipments by water are excluded since they are governed by Coast Guard regulation. Moreover, "hazardous materials" were designated as materials capable of posing an unreasonable risk to health, safety, and property when transported in commerce. The PIRS data, on the other hand, cover spills of oil or hazardous substances in accordance with the Federal Water Pollution Control Act (FWPCA). From inception to 1978 there were no specific or mandatory regulations for hazardous material entries into PIRS. During this time PIRS reports represented spills that posed severe threats to the environment or public health and welfare or that originated from Coast Guard regulated sources, such as vessels or waterfront facilities. In 1978, a list of approximately 300 hazardous substances (40 CFR116) designated under the authority of section 311 of the FWPCA, came into effect, providing a specific basis for entries into PIRS.

The results of the above history is that the HMIR data covers incidents involving hazardous materials in transport, other than bulk water shipments, while PIRS recorded incidents involving hazardous shipments by water, or from waterfront facilities or otherwise threatening U.S. waters.

An outline of the major steps in preparing the three data sources for analysis is given in Figure 3-1. Records were selected from the three sources if they represented spills that

(1) occurred in one of the coastal or waterway counties of Coast Guard interest, as described in Appendix A, and

(2) involved one or more of the hazardous chemicals listed in Appendix B of Reference 3.

The application of these selection criteria alone reduced the PIRS file by 93 percent, the HMIR file by 64 percent and PCAR file by 87 percent as seen in Table 3-1. On average only about 20 percent of the data were employed (39,000 out of about 194,000 spills). The majority of the records originated from the HMIR data base.

The three data sources were analyzed from four points of view:

(1) type of chemical

(2) transportation mode

(3) time history

(4) location

Throughout the data were restricted to certain materials and to the coastal and inland waterways, as described previously.

TABLE 3-1. EXTRACTION OF INCIDENTS FROM PIRS, HMIR, AND PCAR DATA BASES

	Original	Selected for Study
PIRS Data Base	100,940	6,963 incidents
MTB - HMIR Data Base	89,647	31,515
MTB - PCAR Data Base	3,590	491
ALL	194,177	38,969

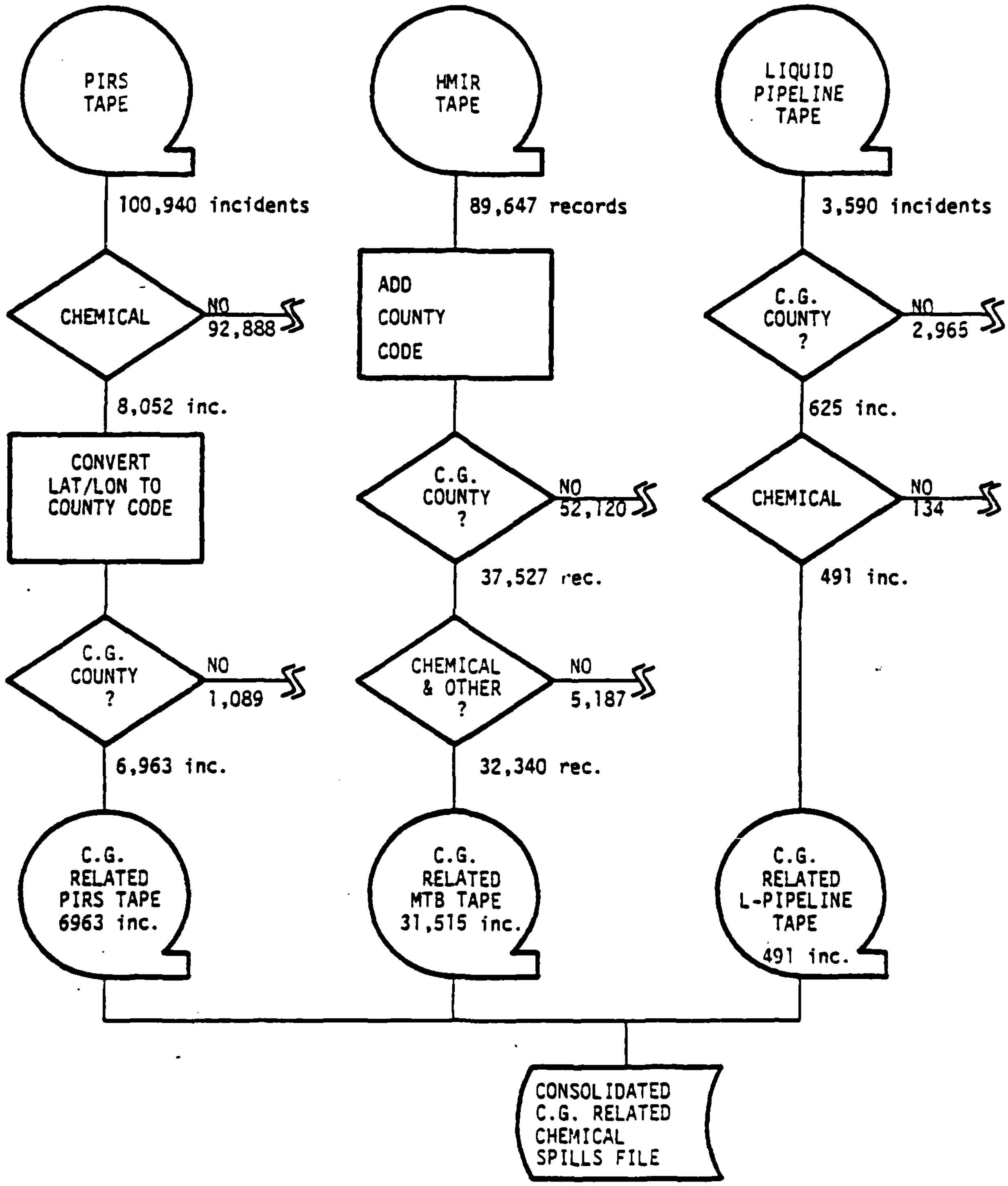


FIGURE 3-1. OUTLINE OF SPILL DATA PROCESSING

3.1 TYPE OF CHEMICAL

The most frequently spilled chemicals as reported through the HMIR system are listed in Table 3-2; as reported to the PIRS system in Table 3-3; and as reported to PCAR in Table 3-4; non-flammable petroleum products and miscellaneous materials were eliminated prior to tabulation so items such as wet batteries and radioactive materials do not appear. (See Tables 3, 4 and 12 of Reference 3 for lists of excluded materials.)

The two lists show significant differences. The PIRS spills include several materials not found in the MTB spills; most significant are hydraulic fluid, vegetable oil and animal oil. The prominence of hydraulic fluid is probably due to its common use in marine equipment. The occurrence of animal nd vegetable oils among marine (PIRS) incidents is probably due to the relatively high frequency with which it is transported by water, as opposed to transport by other modes. In general, however, there is no discernable relation between frequency with which a material appears in the PIRS file and the quantity of the material shipped annually by water in the U.S. (Reference 3, Figure 21).

The most frequently spilled substances on each list (PIRS and MTB) agree in 15 cases. They are shown in Table 3-5. The MTB and PIRS ranks show little correlation. When the two lists are combined with the PCAR list of Table 3-4 and then grouped by chemical category, the result is as shown in Table 3-6. Both PIRS and MTB reports show high percentages of flammable liquids, but differ in the percentage of corrosives reported.

Aside from flammable liquids the largest category of the chemicals (in Table 3-3) reported spilled to PIRS is the "Other than above" category. This can be attributed to the fact that PIRS allows substance-specific entries only for those materials that have been assigned a code (by the system). Prior to 1980, PIRS included only 212 substance-specific codes for non-oils.

3.2 TRANSPORTATION MODE

The modal distribution of chemical spills is shown in Table 3-7 for the PIRS, the MTB (HMIR) and the MTB (PCAR) data. It is apparent that the duplication between the data bases is minimal. The maximum possible duplication is limited by the smaller of the two entries for each mode. An average duplication level for all modes was determined as 3.5 percent. The acutal percent overlap,

TABLE 3-2. FIFTY MOST FREQUENTLY SPILLED CHEMICALS (1971-1979) - MTB DATA BASE

COAST GUARD RELATED HAZARDOUS CHEMICAL SPILL RECORDS - MTB DATA BASE ONLY (1971-1979)

	MTB CHEM.		WJR			WOOR			TOTAL			
RANK	CL	CODE	# REC.	%	CUM. %	# REC.	%	CUM. %	# REC.	%	CUM. %	MTB CHEMICAL DESCRIPTION
1	25	8063	4847	24.16	24.16	2274	18.52	18.52	7121	22.02	22.02	PAINT ENAM LAQ STAN
2	25	5350	1303	6.48	30.64	1595	12.99	31.51	2895	8.95	30.97	GASOLINE
3	95	3490	1384	6.90	37.54	944	7.69	39.20	2328	7.20	38.17	COMP CLEANING LIQ C
4	95	3730	1101	5.49	43.03	360	2.93	42.13	1461	4.52	42.69	CORR LIQ N.O.S.
5	25	5110	1051	5.24	48.27	395	3.22	45.35	1446	4.47	47.16	FLAM LIQUID N.O.S.
6	25	3560	850	4.24	52.50	510	4.15	49.50	1360	4.21	51.36	COMP PAINT REMOVE F
7	95	9930	605	3.02	55.52	474	3.86	53.36	1079	3.34	54.70	SULFURIC ACID
8	25	2840	608	3.03	58.55	399	3.25	56.61	1007	3.11	57.81	CEMENT LIQ NOS
9	95	5700	555	2.77	61.31	360	2.93	59.55	915	2.83	60.64	HYDROCHLORIC ACID
10	25	9030	582	2.90	64.22	124	1.01	60.56	706	2.18	62.83	RESIN SOLUTION
11	95	4560	276	1.38	65.59	252	2.05	62.61	528	1.63	64.46	ELECTR BATT FL
12	25	5960	267	1.33	66.92	168	1.37	63.98	435	1.35	65.80	INK
13	25	1130	258	1.29	68.21	167	1.36	65.34	425	1.31	67.12	ALCOHOL N.O.S.
14	60	8520	267	1.33	69.54	155	1.26	66.60	422	1.30	68.42	POISONOUS LIQ NOS B
15	50	6330	189	0.94	70.48	140	1.14	67.74	329	1.02	69.44	LIQ PETROLEUM GAS
16	95	1120	123	0.61	71.09	149	1.21	68.95	272	0.84	70.28	ACID LIQUID N.O.S.
17	20	3675	208	1.04	72.13	42	0.34	69.29	250	0.77	71.05	COMBUSTIBLE LIQ NOS
18	95	7700	99	0.49	72.62	137	1.12	70.41	236	0.73	71.78	NITRIC ACID
19	95	8365	186	0.93	73.55	42	0.34	70.75	228	0.71	72.49	PHOSPHORIC ACID
20	45	1520	144	0.72	74.27	75	0.61	71.36	219	0.68	73.17	AMMONIA ANHYDROUS
21	25	3500	129	0.64	74.91	86	0.70	72.06	215	0.66	73.83	COMP CLEANING LIQ F
22	95	3735	165	0.82	75.74	42	0.34	72.41	207	0.64	74.47	CORR SOLID N.O.S.
23	25	9720	108	0.54	76.27	90	0.73	73.14	198	0.61	75.08	SOLVENTS N.O.S.
24	60	5980	68	0.34	76.61	130	1.05	74.20	198	0.61	75.70	INSECTICIDE LIQUID
25	95	9575	195	0.97	77.58	0	0.00	74.20	195	0.60	76.30	SODIUM HYDROXIDE LQ
26	25	10820	112	0.56	78.14	82	0.67	74.87	194	0.60	76.90	METHYL ALCOHOL
27	95	2330	20	0.10	78.24	152	1.24	76.10	172	0.53	77.44	CAUSTIC SODA LIQ
28	50	3570	61	0.30	78.55	96	0.78	76.89	157	0.49	77.92	COMPR GASES NOS FG
29	95	3540	98	0.49	79.03	41	0.33	77.22	139	0.43	78.35	COMP RUST REMOVER
30	25	1010	71	0.35	79.39	65	0.53	77.75	136	0.42	78.77	ACETONE
31	25	10890	87	0.43	79.82	45	0.37	78.12	132	0.41	79.17	XYLENE (XYLOL)
32	25	10340	72	0.36	80.18	51	0.42	78.53	123	0.38	79.55	TOLUENE
33	25	8320	66	0.33	80.51	55	0.45	78.98	121	0.37	79.93	PETROLEUM NAPHTHA
34	60	3600	47	0.23	80.74	70	0.57	79.55	117	0.36	80.29	COMP TR & WD KILLER
35	95	2260	80	0.40	81.14	37	0.30	79.85	117	0.36	80.65	BOILER COMP LIQ
36	95	3510	85	0.42	81.57	18	0.15	80.00	103	0.32	80.97	COMP PAINT REMOVE C
37	25	6000	74	0.37	81.94	27	0.22	80.22	101	0.31	81.28	INSECTICIDE LIQ FL
38	95	4430	16	0.08	82.02	85	0.69	80.91	101	0.31	81.60	DRUGS CHEMICALS COR
39	95	1240	63	0.31	82.33	37	0.30	81.21	100	0.31	81.90	ALKALINE LIQUID NOS
40	35	7731	92	0.46	82.79	0	0.00	81.21	92	0.28	82.19	NITRIC ACID >40%
41	35	8010	53	0.26	83.05	38	0.31	81.52	91	0.28	82.47	OXI MATERIAL N.O.S.
42	45	3660	31	0.15	83.21	57	0.46	81.98	88	0.27	82.74	COMPR GASES NOS NFG
43	25	3390	61	0.30	83.51	24	0.20	82.18	85	0.26	83.01	COMP TR-WD KILL FL
44	95	10710	66	0.33	83.84	19	0.15	82.33	85	0.26	83.27	WATER TREAT COMP
45	60	2670	45	0.22	84.06	37	0.30	82.64	82	0.25	83.52	CARBOLIC ACID LIQ
46	95	5870	57	0.28	84.35	21	0.17	82.81	78	0.24	83.76	HYPOCHLORITE SOL
47	95	5770	39	0.19	84.54	37	0.30	83.11	76	0.24	84.00	HYDROFLUORIC AC SLN
48	25	7330	48	0.24	84.78	26	0.21	83.32	74	0.23	84.23	OIL N.O.S.
49	95	1336	74	0.37	85.15	0	0.00	83.32	74	0.23	84.46	AMMON HYDROXIDE <45
50	95	5850	16	0.08	85.23	57	0.46	83.78	73	0.23	84.68	HYDROGEN PEROXIDE
629											100.00	
TOTAL			20062		100.00	12279		100.00	32340		100.00	

TABLE 3-3. MOST FREQUENTLY SPILLED CHEMICALS, 1973-1979, AS REPORTED TO USCG/PIRS

RANK	MATERIAL(1)	NUMBER OF SPILLS	%	CUM %	MATERIAL NAME
1	1011	3179	45.65	45.65	Gasoline (Aviation or Automotive)
2	1091	873	12.54	58.18	Hydraulic Fluid
3	2097	408	5.86	64.04	Other Hazardous Substances
4	1092	333	4.78	68.83	Lacquer-Based Paint
5	1010	252	3.62	72.44	Natural (Casinghead) Gasoline
6	1071	221	3.17	75.62	Vegetable Oil
7	1070	163	2.34	77.96	Animal Oil
8	1030	116	1.67	79.62	Naphtha
9	1032	109	1.57	81.19	Other Petroleum Solvent
10	2096	105	1.51	82.70	Xylene
11	1090	93	1.34	84.03	Liquefied Petroleum Gas
12	2018	93	1.34	85.37	Benzene
13	2089	93	1.34	86.70	Toluene
14	2086	92	1.32	88.02	Styrene
15	2087	86	1.23	89.26	Sulphuric Acid
16	7016	75	1.08	90.34	Industrial Waste
17	2030	56	0.80	91.14	Caustic Soda
18	2060	46	0.66	91.80	Hydrochloric Acid
19	7008	46	0.66	92.46	Chemical Wastes
20	1031	45	0.65	93.11	Mineral Spirits
21	1093	39	0.56	93.67	Paraffin Wax
22	2033	29	0.42	94.08	Cresol
23	2165	21	0.30	94.39	Napthalene
24	2013	20	0.29	94.67	Ammonia
25	2082	20	0.29	94.96	Phosphoric Acid
26	1096	19	0.27	95.23	Oil-Based Pesticides
27	2080	18	0.26	95.49	Phenol
28	2190	18	0.26	95.75	Sodium Hydroxide
29	2035	15	0.22	95.96	Cyclo-Hexane
30	2104	14	0.20	96.17	Ammonium Compounds
31	2093	13	0.19	96.35	Turpentine
32	2064	10	0.14	96.50	Isopropyl Alochol
33	2067	10	0.14	96.64	Methyl Alochol
34	2118	10	0.14	96.78	Chlorine
35	2101	9	0.13	96.91	Acetic Acid
36	2003	8	0.11	97.03	Acetone
37	2009	7	0.10	97.13	Acryllonitrile
38	2046	7	0.10	97.23	Glycol
39	2053	7	0.10	97.33	Ethylene Glycol
40	2079	7	0.10	97.43	Perchloroethylene (Tetrachloroethyl)
41	2114	7	0.10	97.53	Calcium Compounds
42	2122	7	0.10	97.63	Copper Compounds

TABLE 3-3. MOST FREQUENTLY SPILLED CHEMICALS, 1973-1979
AS REPORTED TO USCG/PIRS (Cont.)

RANK	MATERIAL[1]	NUMBER OF SPILLS	%	CUM %	MATERIAL NAME
43	2069	6	0.09	97.72	Methyl Ethyl Ketone (2-Butunone)
44	2075	6	0.09	97.80	Nitric Acid
45	2094	6	0.09	97.89	Vinyl Acetate
46	2120	6	0.09	97.98	Chromium Compounds
47	2078	5	0.07	98.05	Oleum
48	2153	5	0.07	98.12	Lead Compounds
49	2213	5	0.07	98.19	Zinc Compounds
50	2029	4	0.06	98.25	Carbon Tetrachloride
51	2049	4	0.06	98.31	Ethyl Acrylate
52	2050	4	0.06	98.36	Ethyl Alcohol
53	2091	4	0.06	98.42	Trichloroethylene
54	2124	4	0.06	98.48	Cyanide Compounds
55	2145	4	0.06	98.54	Ethylbenzene
56	2002	3	0.04	98.58	Acetic Anhydride
57	2008	3	0.04	98.62	Acrylic Acid
58	2027	3	0.04	98.66	Bromine
59	2070	3	0.04	98.71	Methyl ISO-Butyl Ketone
60	2072	3	0.04	98.75	Methyl Methacrylate
61	2103	3	0.04	98.79	Aluminum Sulfate (Alum)
62	2117	3	0.04	98.84	Chlordane
63	2173	3	0.04	98.88	PCB'S
64	2180	3	0.04	98.92	Potassium Permanganate
65	2204	3	0.04	98.97	Toxaphene
66	2001	2	0.03	98.99	Acetaldehyde
67	2011	2	0.03	99.02	Allyl Alcohol
68	2022	2	0.03	99.05	N-Butyl Acrylate
69	2023	2	0.03	99.08	N-Butyl Alcohol
70	2025	2	0.03	99.11	N-Bulyraldehyde
71	2031	2	0.03	99.14	Chloroform
72	2039	2	0.03	99.17	Dichloropropane-Dichloropropane Mix
73	2052	2	0.03	99.20	Ethylenediamine
74	2055	2	0.03	99.22	Formaldehyde
75	2062	2	0.03	99.25	Hydrogen Peroxide (Greater Than 60%)
76	2083	2	0.03	99.28	N-Propyl Alcohol
77	2090	2	0.03	99.31	Trichloroethane
78	2095	2	0.03	99.34	Vinylidene Chloride
79	2151	2	0.03	99.37	Iron Compounds
80	2156	2	0.03	99.40	Maleic Acid
81	2169	2	0.03	99.43	Nitrogen Dioxide
82	2172	2	0.03	99.45	Parathion
83	2174	2	0.03	99.48	Pentachlorophenol
84	2181	2	0.03	99.51	Propionic Acid

TABLE 3-3. MOST FREQUENTLY SPILLED CHEMICALS, 1973-1979
AS REPORTED TO USCG/PIRS (Cont.)

RANK	MATERIAL[1]	NUMBER OF SPILLS	%	CUM %	MATERIAL NAME
85	2191	2	0.03	99.54	Sodium Hypochlorite
86	2199	2	0.03	99.57	Sulfur Monochloride
87	2211	2	0.03	99.60	Xylenol
88	2004	1	0.01	99.61	Acetone Cyanohydrin
89	2005	1	0.01	99.63	Acentronitrile (Methylcyanide)
90	2015	1	0.01	99.64	N-Amyl Alcohol
91	2021	1	0.01	99.66	N-Butyl Acetate
92	2024	1	0.01	99.67	Butyl Ether
93	2026	1	0.01	99.68	Butyric Acid
94	2044	1	0.01	99.70	Dimethylamine (40% Aqueous)
95	2047	1	0.01	99.71	Epichlorohydrin
96	2048	1	0.01	99.73	Ethyl Acetate
97	2051	1	0.01	99.74	Ethylene Cyanohydrin
98	2058	1	0.01	99.76	Glycerine
99	2059	1	0.01	99.77	N-Hexane
100	2061	1	0.01	99.78	Hydrofluoric Acid (40% Aqueous)
101	2063	1	0.01	99.80	Isoprene
102	2066	1	0.01	99.81	Methyl Acrylate
103	2085	1	0.01	99.83	Propylene Oxide
104	2088	1	0.01	99.84	Tetraethyl Lead
105	2112	1	0.01	99.86	Butylamine
106	2146	1	0.01	99.87	Flourine Compounds
107	2161	1	0.01	99.89	Methyl Parathion
108	2178	1	0.01	99.90	Phosphorus Trichloride
109	2188	1	0.01	99.91	Sodium Bisulfite
110	2189	1	0.01	99.93	Sodium Hydrosulfide
111	2193	1	0.01	99.94	Sodium Nitrite
112	2195	1	0.01	99.96	Sodium Phosphate, Monobasic
113	2197	1	0.01	99.97	Sodium Sulfide
114	2198	1	0.01	99.99	Strychnine
115	2209	1	0.01	100.00	Uranium Compounds
TOTALS:		6964		100.00	

(1) Material Identification Number, according to Reference 2.

TABLE 3-4. MOST FREQUENTLY SPILLED LIQUIDS (1968-1979) SELECTED FROM MTB (PCAR) REPORTS

RANK	CHEM-CODE	CHEMICAL DESCRIPTION	#INCIDENTS	%	COM%
1	28 141 13	Anthracene, Crude	330	67	67
2	29 111 35	Gasoline, Blended			
	29 111 90	Gasoline, n.e.c.(1)			
	49 081 76	Gasoline, Casing Head	117	24	91
3	49 057 11	Liquified Petroleum	44	9	100
			491		100

(1) Not otherwise classified

TABLE 3-5. MATERIALS APPEARING ON BOTH PIRS AND MTB LISTS OF MOST FREQUENTLY SPILLED SUBSTANCES

MATERIALS	RANK IN PIRS LIST [1]	RANK IN MTB LIST [2]
Gasoline	1 (8.7)[3]	2 (3.2)[4]
Paint	4 (34.8)	1 (1.6)
Naptha	8 (69.6)	33 (52.5)
LPG	9 (78.3)	15 (23.8)
Xylene	11 (95.7)	31 (49.3)
Sulphuric Acid	13 (113.0)	7 (11.1)
Toluene	14 (121.7)	32 (50.9)
Caustic Soda	17 (147.8)	27 (42.9)
Hydrochloric Acid	18 (156.5)	9 (14.3)
Phosphoric Acid	23 (200.2)	19 (30.2)
Ammonia	25 (217.4)	20 (31.8)
Sodium Hydroxide	27 (234.8)	25 (39.7)
Pesticide (flammable)	28 (243.5)	37 (58.8)
Acetone	32 (278.3)	30 (47.7)
Methyl Alcohol	35 (304.3)	26 (41.3)
Nitric Acid	38 (330.4)	18 (28.6)

Correlation coefficient between PIRS and MTB normalized rank lists = 0.43.

(1) PIRS list of chemicals included in study and spilled in counties of interest, 1973-79. (See text.)

(2) MTB list of chemicals included in study and spilled in counties of interest, 1971-79. (See text.)

(3) Rank in PIRS list, normalized to 115 chemicals spilled, times 1000.

(4) Rank in MTB list, normalized to 629 chemicals spilled, times 1000.

TABLE 3-6. MOST FREQUENTLY SPILLED CHEMICALS REPORTED TO PIRS AND MTB, BY CHEMICAL GROUP

	PIRS		MTB[1]	
	spills	%	spills	%
Flammable Liquids	6,867	85	13,970	58
Corrosives	340	4	8,181	34
Poisons	-	-	740	3
Flammable Gases	132	2	540	2
Non-Flammable Gases	35	0	219	1
Other than above	709	9	422	2
	8,083	100	24,072	100

[1]Includes PCAR (Pipeline Carrier Accident Reports)

TABLE 3-7. COAST GUARD RELATED HAZARDOUS CHEMICAL SPILLS - '71-'79

	PIRS		MTB		TOTAL		
MODE	# INCIDENTS	%	# INCIDENTS	%	# INCIDENTS	%	LEVEL OF DUPLICATION
AIR[1]	10	0.1	611	1.9	621	1.6	0 duplicates
PIPELINE[2]	183	2.6	355	1.0	518	1.3	5 duplicates
HIGHWAY[3]	811	11.7	27,831	87.4	28,463	73.8	not investigated
RAIL[4]	88	1.3	2,792	8.8	2,880	7.4	14 duplicates
WATER[5]	2,762	39.7	130	0.4	2,892	7.5	1 duplicate
LAND AND MARINE FACILITIES[6]	2,262	33.0	50	0.2	2,342	6.0	0 duplicates
OTHERS[7]	806	11.6	101	0.3	907	2.3	0 duplicates
TOTAL	6,952	100.0	31,850	100.0	38,802	100.0	20 duplicates
% OF TOTAL		17.9		82.1		100.0	
DATA PERIODS	('73-'79)		('71-'79)				

[1]PIRS Source Code 209, HMIR Mode 1

[2]PIRS Source Codes 400-402, All PCAR

[3]PIRS Source Codes 205-208, 303-304; HMIR Modes 4 and 5

[4]PIRS Source Codes 201-204, 301-302; HMIR Mode 6

[5]PIRS Source Codes 0-58, 108, HMIR Mode 7

[6]PIRS Source Codes 100-107, 500-508, 300; HMIR Mode 8

[7]PIRS Source Codes 200, 900-999; HMIR Mode 9

however, is substantially less, for most modes as shown in the last column of Table 3-7. The duplicate reocrds discovered represent an average overlap of less than 0.5 percent.

The reasons for the low overlap fractions are not difficult to find.

(1) Incident reports are not made to the MTB for bulk shipments by water, but are required under the PIRS. Hence the PIRS reports of water incidents seldom duplicate the MTB reports.

(2) Most highway and rail spills probably do not impact the navigable waters, even though they occur in coastal or waterway counties. If so, they would appear in the PIRS data with much lower frequency than in the MTB data.

(3) The category of marine and land facility does not apply to MTB recorded incidents, except as these later are of unknown mode. Since there are relatively few records of that type in the MTB data, the overlap is small.

Because of the low overlap it was deemed unnecessary to consolidate PIRS amd MTB data into a single data base, i.e., to eliminate duplication. The PIRS data can be taken to reflect water-borne and facility spills, while the MTB data can be taken to cover highway and rail spills. Pipeline spill data, however, must be extracted from both sources. Also, a check of the air-mode spills showed no overlap.

Figures 3-2 and 3-3 illustrate the breakdown by mode of the PIRS and MTB data.

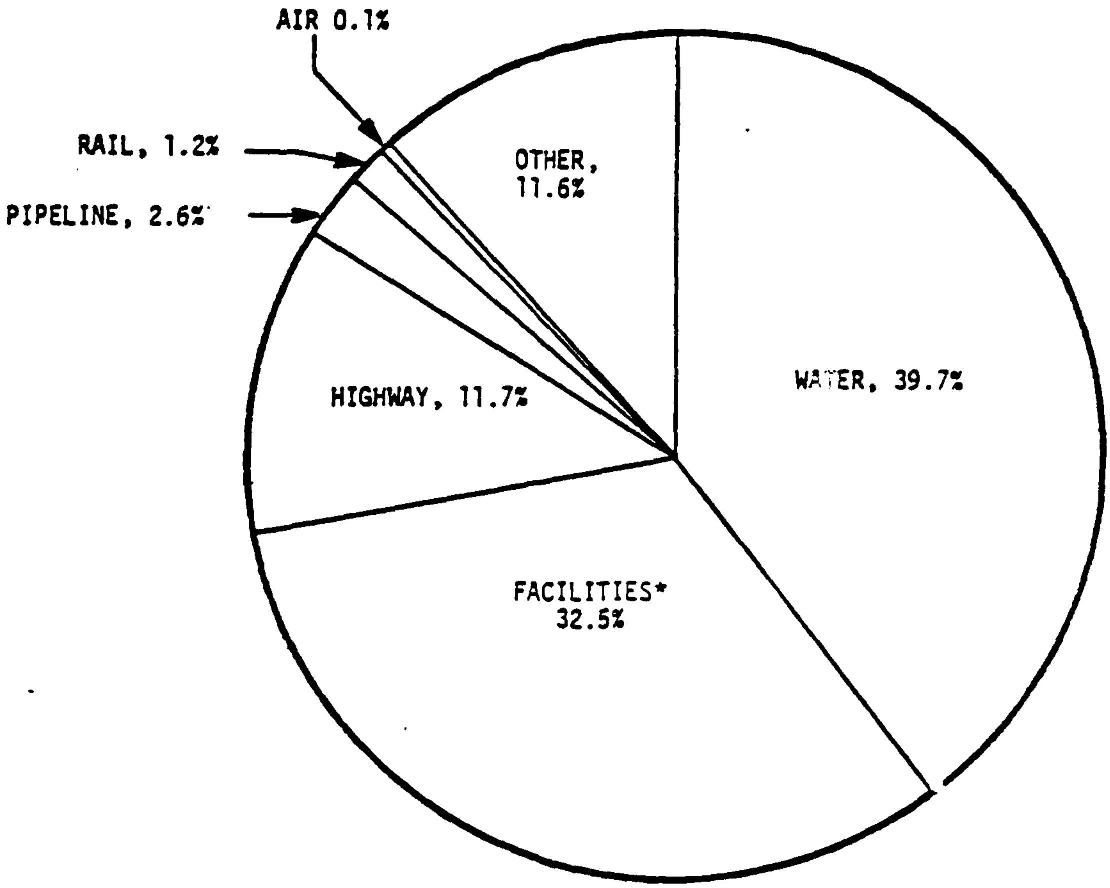
The overall picture emerging from the modal breakdown, for the chemicals and counties covered, is:

(1) Water-borne incidents occur at the rate of about 300 per year.

(2) Spills at facilities, affecting the navigable waters, occur at the rate of about 250-year.

(3) About 3 percent of all highway spills reported to the MTB in the coastal counties (about 90 per year) are reported in the PIRS data base as affecting the navigable waters.

(4) Railroad incidents in the counties of interest occur at about one tenth the rate of highway incidents.



*MARINE FACILITIES, NON-TRANSPORTATION FACILITIES, AND LAND TRANSPORTATION FACILITIES OTHER THAN RAIL AND HIGHWAY.

FIGURE 3-2. COAST GUARD RELATED HAZARDOUS MATERIAL INCIDENTS - PIRS DATA BASE

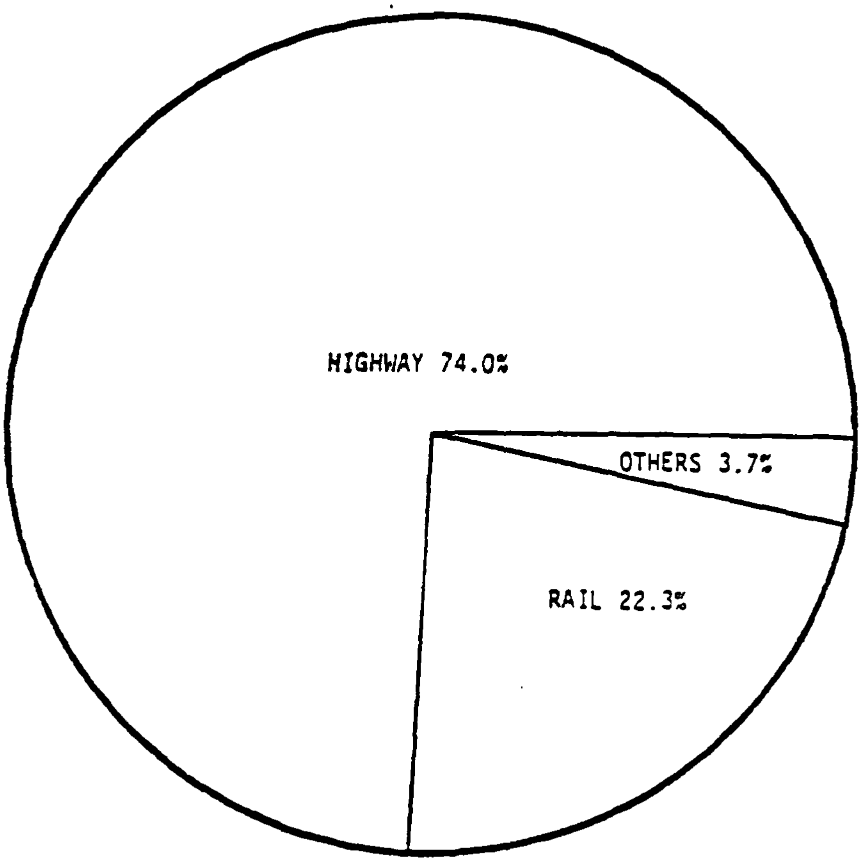


FIGURE 3-3. COAST GUARD RELATED HAZARDOUS MATERIAL INCIDENTS - MTB DATA BASE (MINIMUM DAMAGE = $1,000.00) TOTAL INCIDENTS = 2,358

Item (3) above deserves some discussion. The use of coastal and waterway counties to represent the shorelines adjacent to U.S. navigable waters is clearly only an approximation, at least for highway incidents. Only a small portion of the MTB recorded highway spills are reported in PIRS, presumably because they do not affect the shoreline or waters. Similarly, only a small fraction of the MTB rail incidents are recorded in PIRS, presumably for the same reason. The data, then, suggest that the county is not equivalent to "adjacent shorelines." This lack of equivalence, however, does not necessarily negate the value of the county plots. If the fraction of all spills within a county that affect the water is fixed from county to county, then the relative distribution of county-wide incidents is indicative of the distribution of the subset of incidents that affect the water. It remains to be seen whether or not such a fixed fraction exists, however.

3.3 TIME HISTORY

The time history of spill incidents from 1971-1979 is shown in Figure 3-4 for the PIRS data and in Figure 3-5 for the MTB-HMIR data.

The PIRS was initiated in December 1971 (Reference 7) and was expanded in 1973 to cover all polluting incidents reportable under the Federal Water Pollution Control Act of 1972. The number of incidents reported through the PIRS increased at about 10 percent per year from 1974 through 1977, and then declined at about 8 percent per year in 1978 and 1979 (Figure 3-4).

It was not possible to determine the causes of the 1977-79 decline in PIRS spill report frequency, but some possible explanations are (1) the USCG spill prevention program, (2) stricter enforcement of FWPCA penalties for spills, (3) the publication in 1978 by the EPA of 298 materials designated as "hazardous substances" and associated penalties for spillage. This list may have served to screen out many non-specific materials from the reporting process.

The MTB data, in contrast to those of PIRS, shows a consistent increase from 1971 through 1979, except for 1977. The drop in 1977, however, was traced to the elimination in that year of some 7700 reports from the HMIR file before it had been acquired for the present study. The number of reports by year, as contained in the original HMIR data base before extraction on the basis of county and material, is shown in Figure 3-6. This Figure does not show the 1977 drop. Also, it shows a slight decrease from 1978 to 1979, rather than

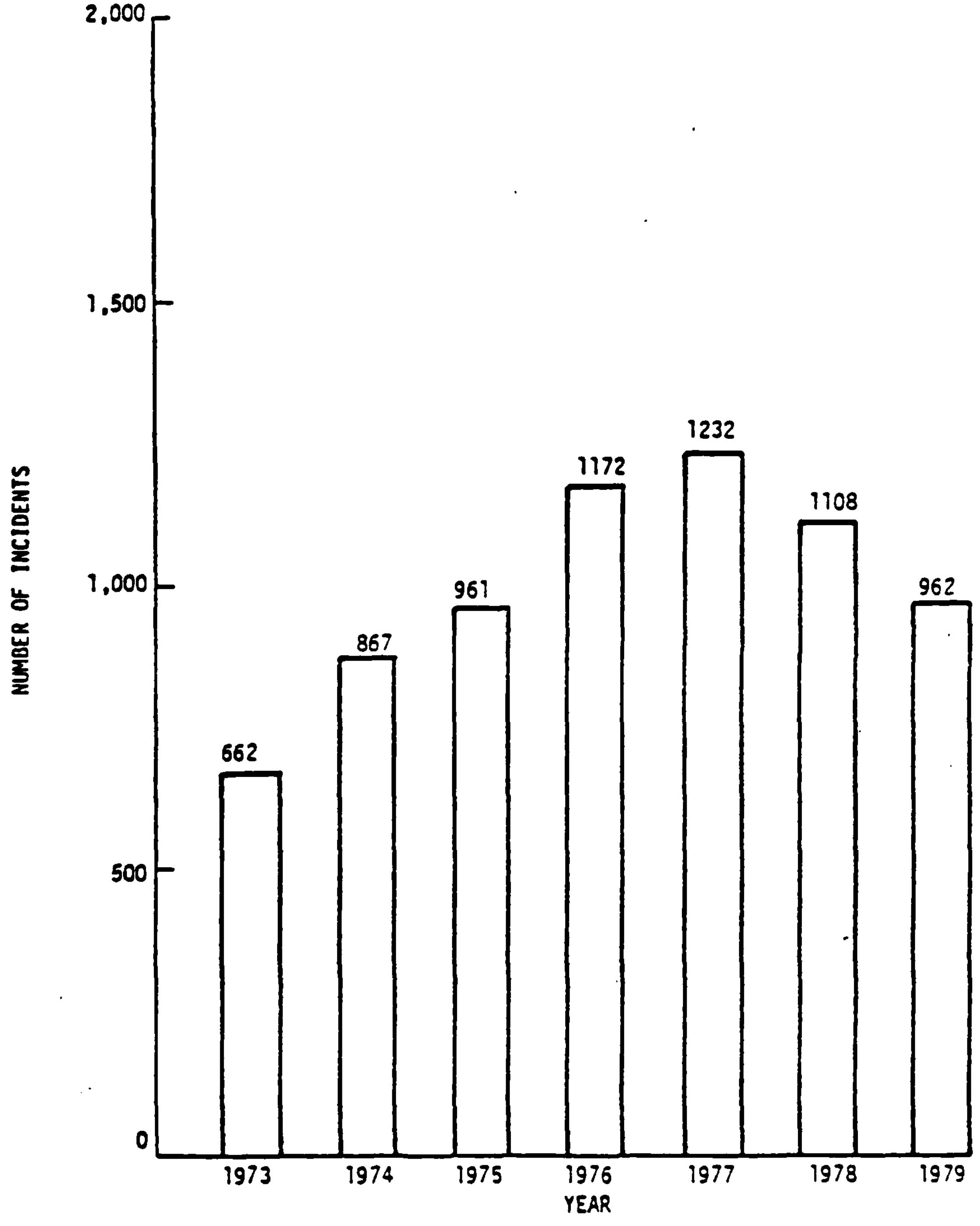


FIGURE 3-4. COAST GUARD RELATED HAZARDOUS MATERIAL SPILLS PIRS DATA BASE (TOTAL 6,964 INCIDENTS)

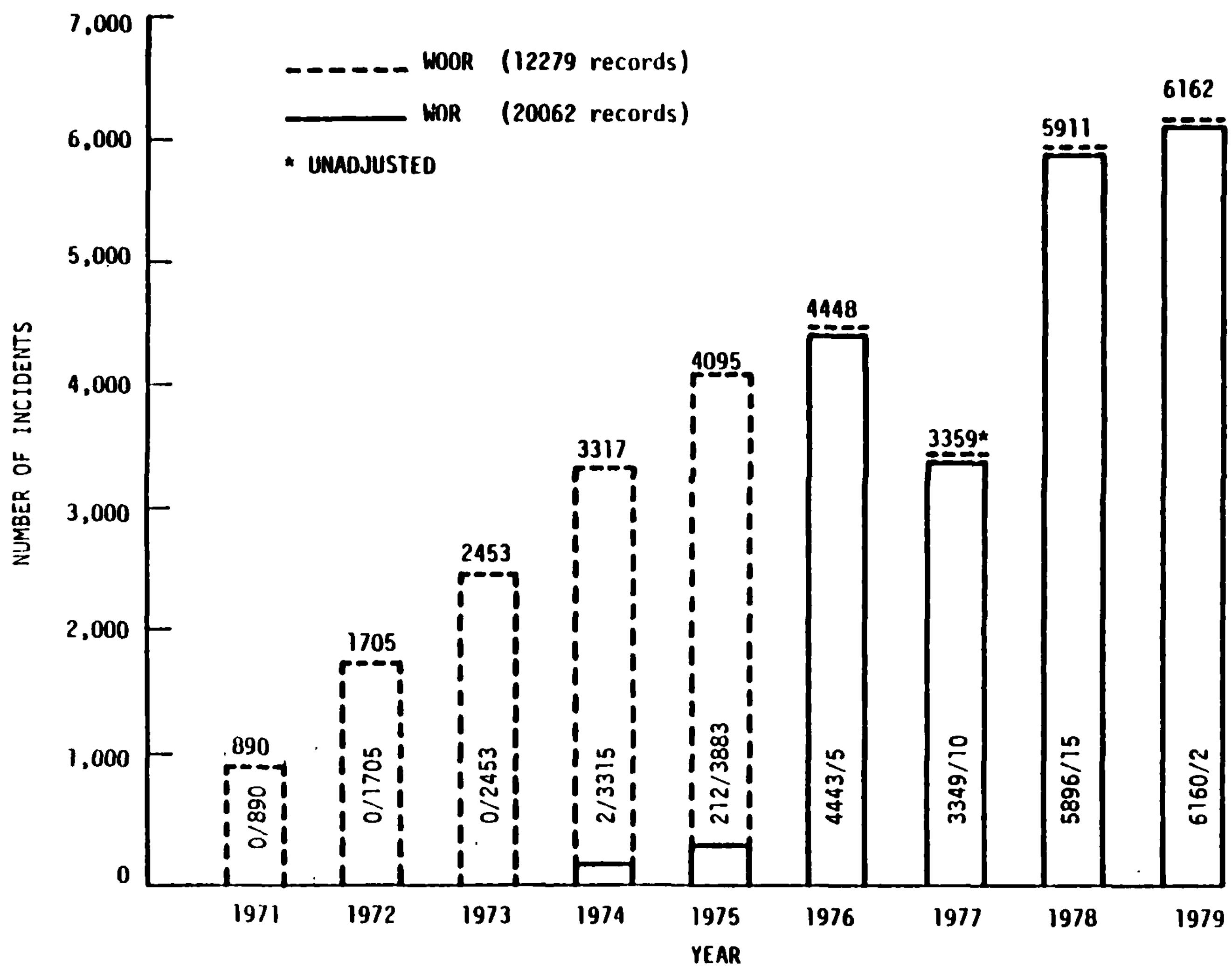


FIGURE 3-5. COAST GUARD RELATED HAZARDOUS MATERIAL SPILLS – MTB DATA BASE (TOTAL 31,515 INCIDENTS)

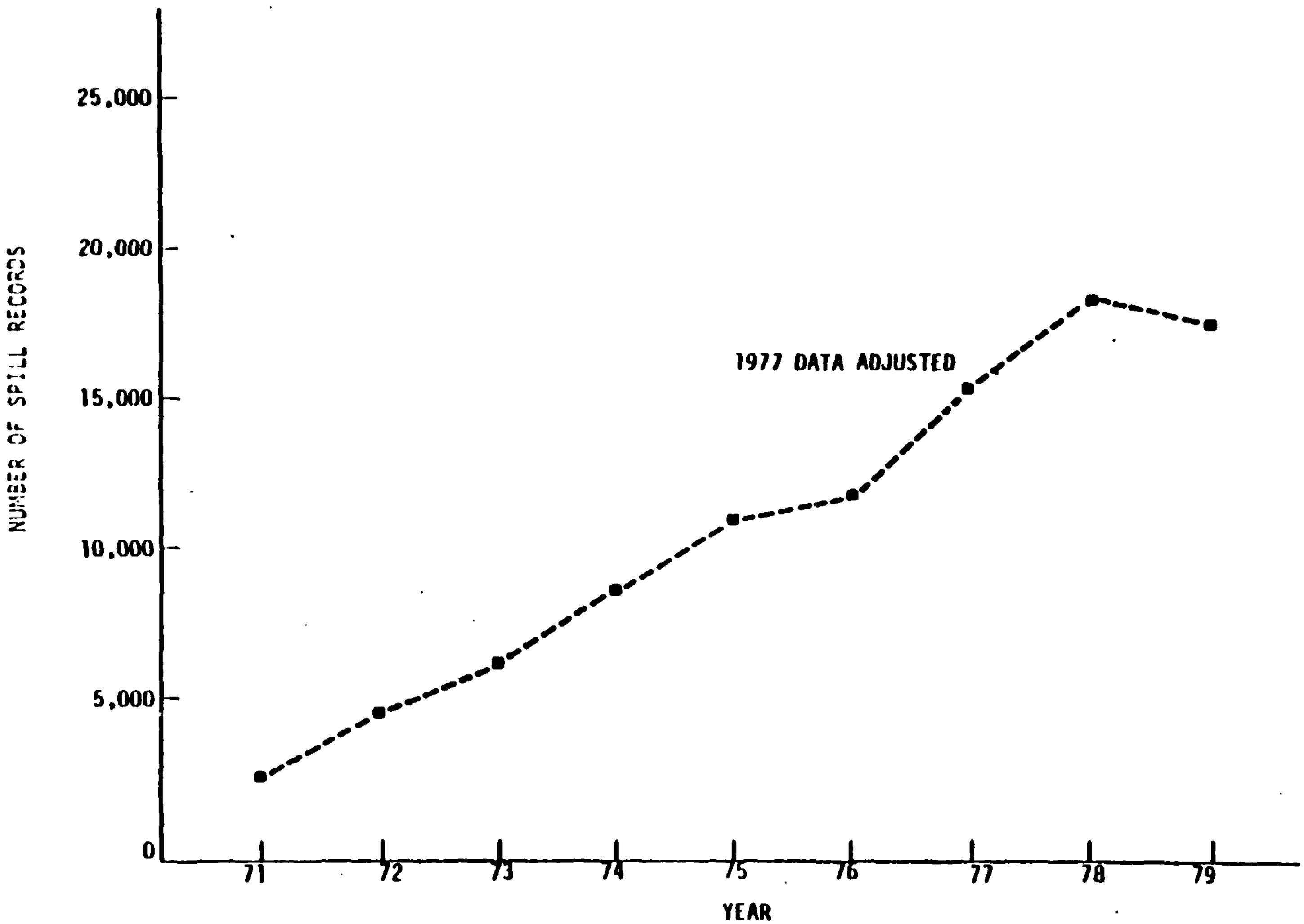


FIGURE 3-6. NUMBER OF HAZARDOUS MATERIAL SPILL RECORDS REPORTED TO MTB

the slight increase shown in Figure 3-5. This, and other minor differences, are probably due to the extraction process, which eliminated non-coastal or waterway county data and spills of certain materials.

The yearly increase in MTB-HMIR reports, however, shows strongly in both the original and in the extracted data. In the extracted data (Figure 3-5) the increase averages 26 percent per year (from 1972 through 1979, excluding 1977). It is generally conceded, however, that the increase in MTB reports per year in the 1971-1979 period, does not necessarily imply a corresponding increase in the frequency of spills, for several reasons:

(1) The MTB conducted an expanding educational program throughout the 70's to inform more shippers of their reporting requirements.

(2) The number of reportable hazardous substances has grown considerably since 1971.

(3) Chemical production, shipment and haul length may have changed since 1971.

3.4 LOCATION

The geographic distribution of spill incidents is of prime concern to the deployment analysis. Some of the important questions to be answered are:

- What is the geographic distribution of spill incidents in general, i.e., for all chemicals and all modes? Do incidents cluster near industrial areas, or are they uniformly distributed throughout the region of interest?
- Are different chemical types spilled preferentially in different regions of the country, or are all chemicals spilled uniformly throughout all regions?
- What is the effect of mode on the geographic distribution of incidents?

The results of the modal analysis (Section 3.2) allow one to separate the MTB and PIRS data by mode, to a great extent, as follows:

Water: PIRS

Facilities: PIRS

Rail: MTB

Highway: MTB

Pipeline: MTB + PIRS

Air: MTB

The geographic distribution of incidents, is obtained in terms of county of occurrence but, not all spills in a county of interest affect the navigable waters of the U.S. This is deduced from the large differences between PIRS and MTB data in most counties. The MTB data includes many more incidents, in general, than the PIRS. One explanation of this is the inclusion in the MTB data of many incidents that do not affect the navigable waters of the United States even though they occurred in a county of interest.

PIRS - Geographic Distribution

The chemicals appearing in the PIRS data base were divided into three groups, for convenience in plotting:

1. Flammable Oils: Gasoline, solvents, light flammable oils, paint, LPG, animal and vegetable oils.

2. Chemicals: PIRS chemical codes 2000-2999, plus oil-based pesticides.

3. Chemical and Industrial Wastes: PIRS Codes 7008, 7016.

The third category involves only 121 incidents (less than 2 percent of the incidents of interest) and hence could not provide any detailed information regarding their geographic distribution over the 612 counties of interest. (But the total quantity spilled of chemical and industrial wastes comprises 15 percent of the total spillage in 1973-79. Most of this spillage was chemical wastes released from tankers.)

Figures 3-7(a) through (d) shows the geographic distribution of incidents reported to PIRS in 1973-79 in the counties of interest. Unshaded counties experienced no incidents in the period; counties in black experienced more than nine times the average number of incidents. Intermediate shadings indicate frequencies of incidents between these extremes. The pattern shows incidents in the heavily industrialized counties of the country. These are listed in Table 3-8, which shows those counties having 50 or more spills of flammable oils or chemicals from 1973 to 1979, as recorded in PIRS. Since the average number of incidents per county is about 8.6, the occurrence of over 50 spills in any one county is a very significant deviation from the average.

The regional distribution of PIRS spill incidents is as follows:

PIRS – ALL MATERIALS
1971–79 ALL MODES # INCIDENTS = 6,952

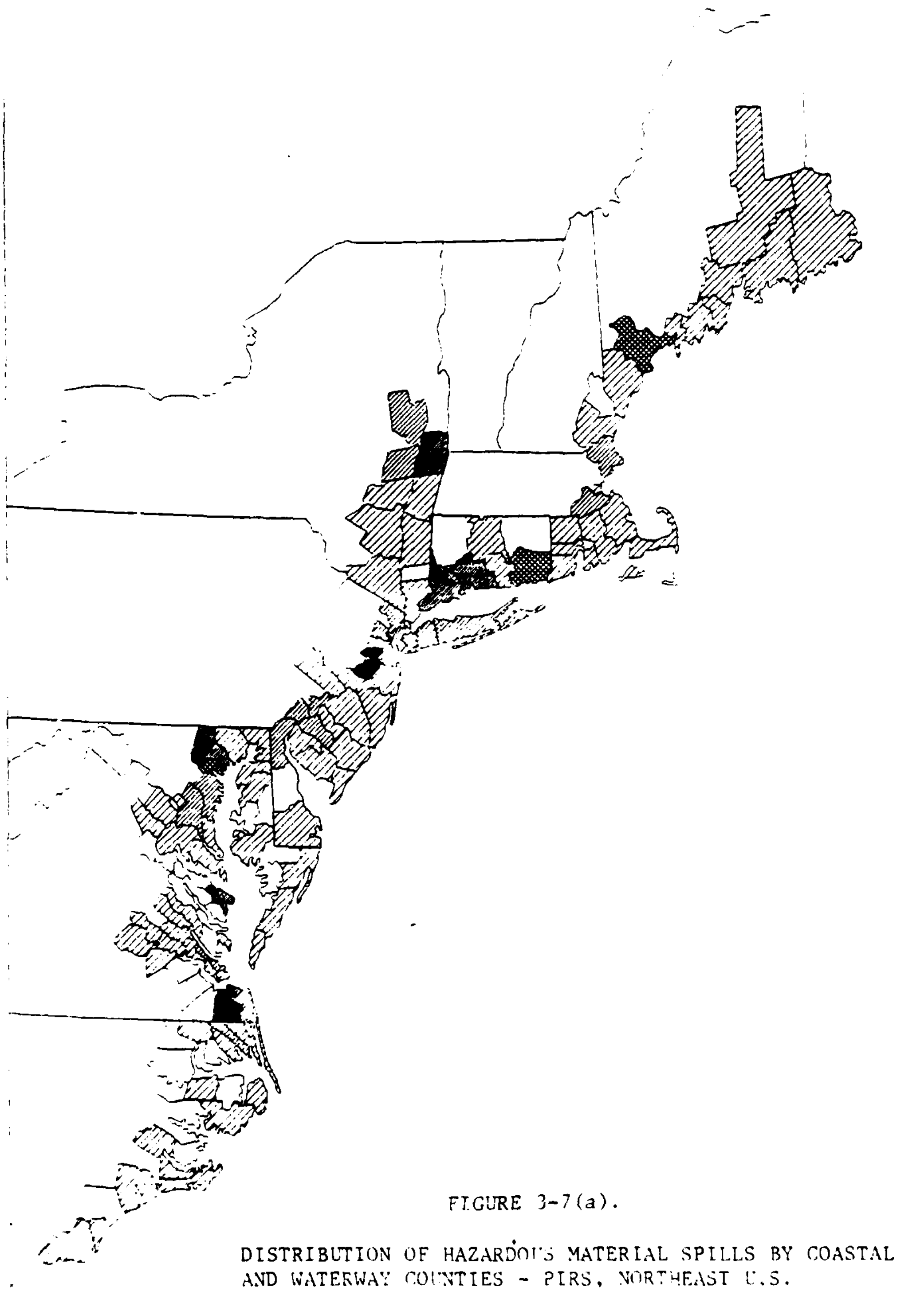


FIGURE 3-7(a).

DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES – PIRS, NORTHEAST U.S.

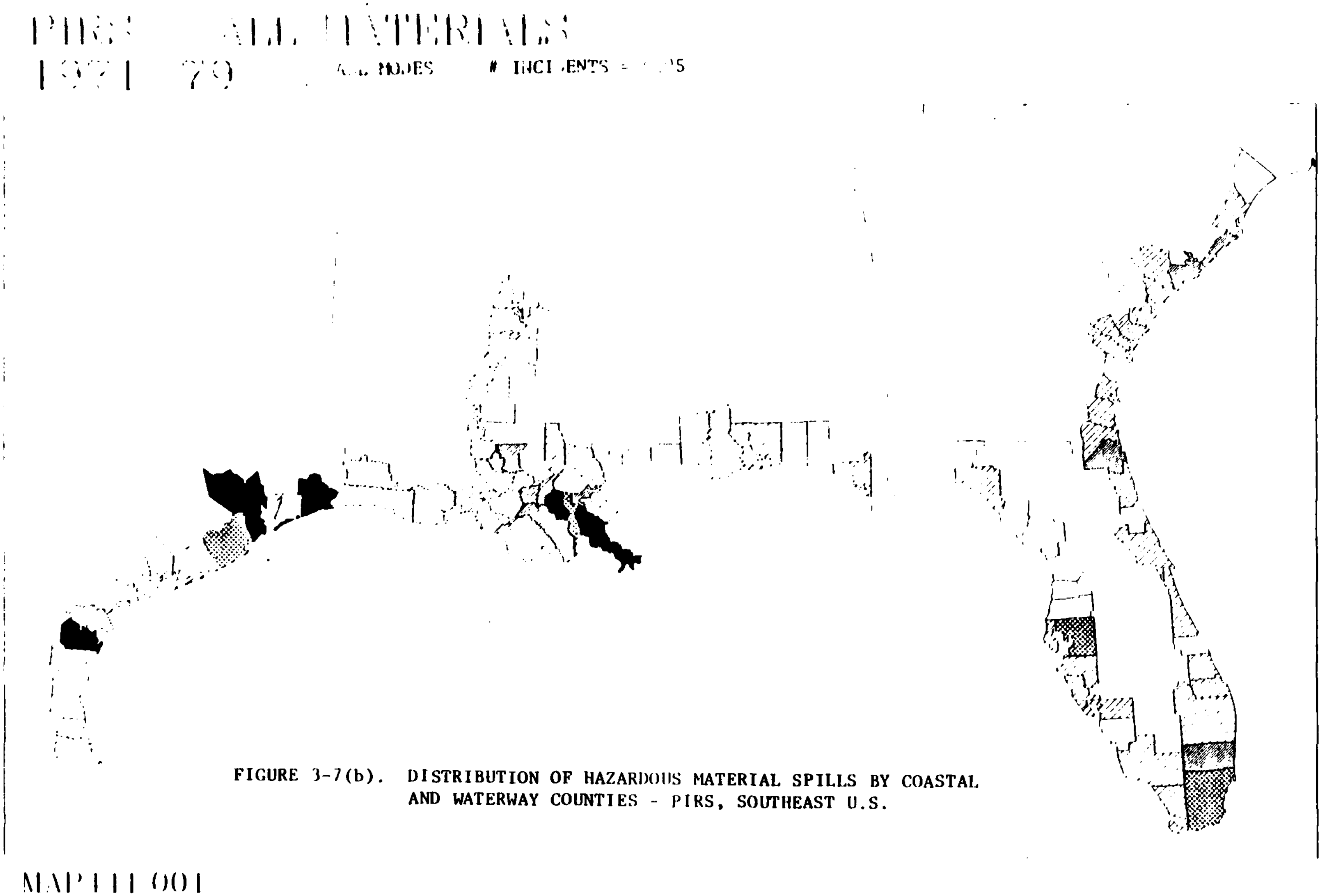


FIGURE 3-7(b). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - PIRS, SOUTHEAST U.S.

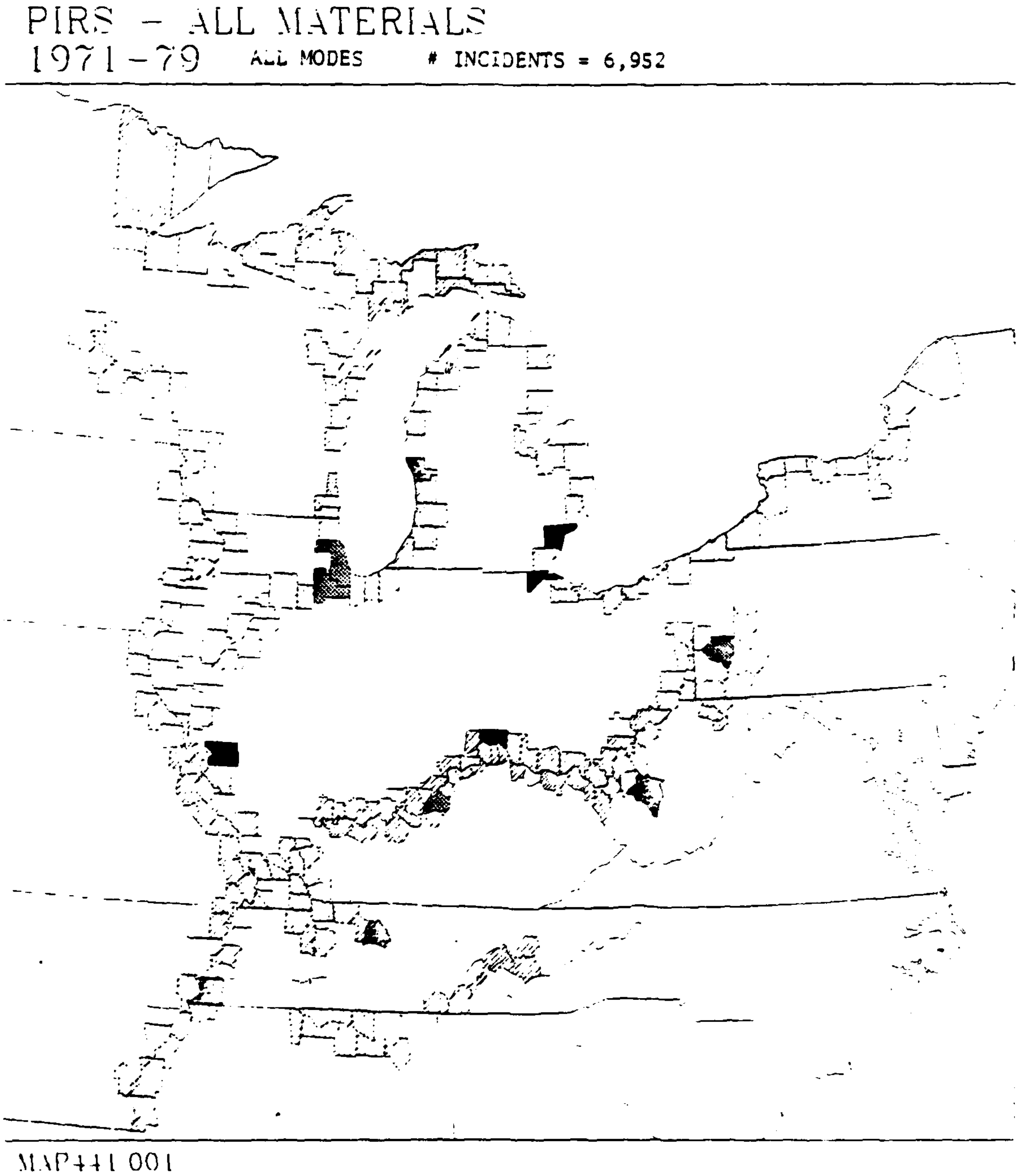
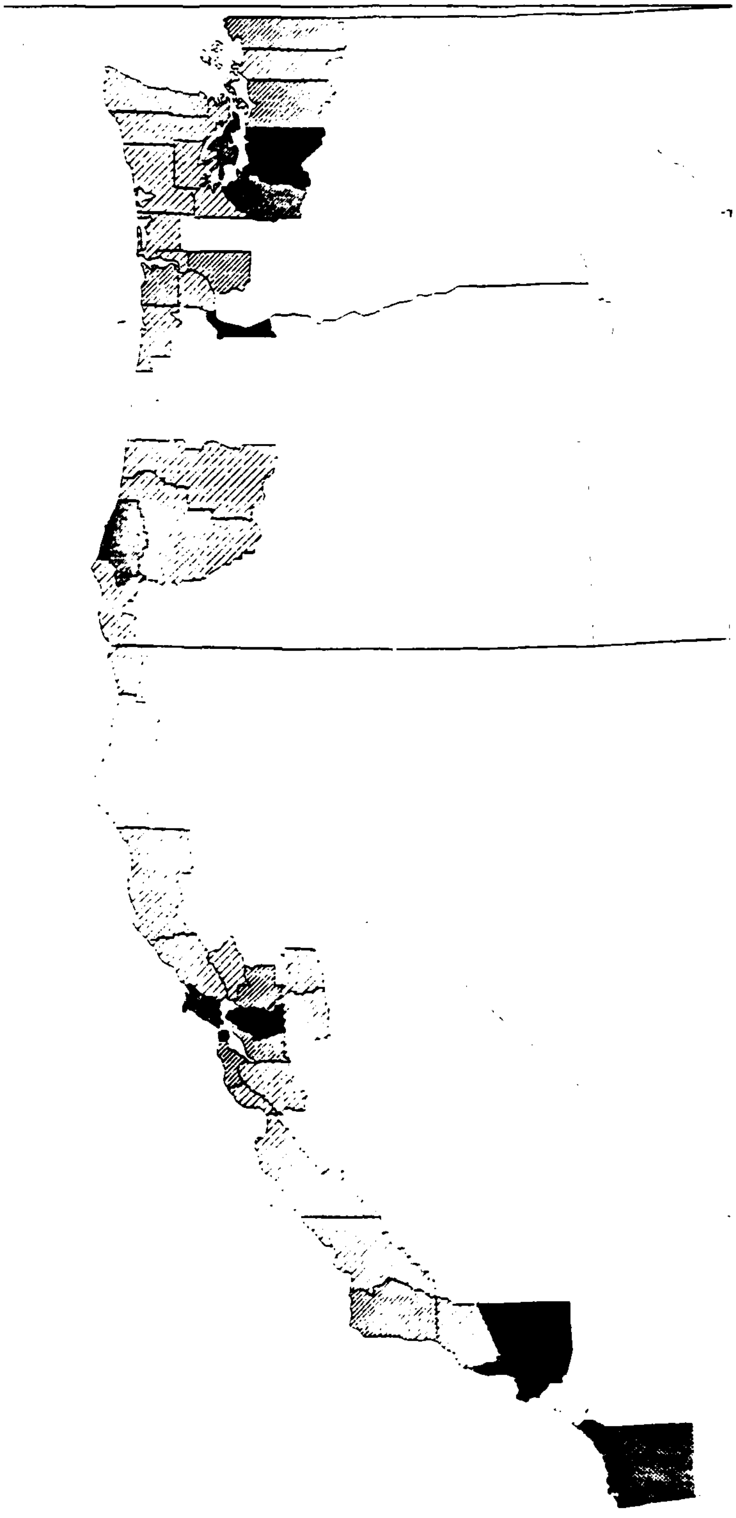


FIGURE 3-7(c). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - PIRS, CENTRAL U.S.

PIRS - ALL MATERIALS
1971-79 ALL MODES # INCIDENTS = 6 952



MAP441.001

FIGURE 3-7(d). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - PIRS, WESTERN U.S.

TABLE 3-8. COASTAL AND WATERWAY COUNTIES HAVING 50 OR MORE[1] HAZARDOUS CHEMICAL SPILLS IN 1973-79, AS RECORDED BY PIRS-USCG

COUNTY #	COUNTY NAME	STATE	NUMBER OF INCIDENTS
11008	Cumberland	ME	54
11025	New London	CT	57
11049	Hudson	NJ	57
11052	Middlesex	NJ	103
11080	Baltimore City	MD	55
11115	Norfolk	VA	142
13024	Dade	FL	53
13031	Hillsboro	FL	62
13062	St. Charles	LA	90
13063	Jefferson	LA	56
13066	Plaquemines	LA	104
13075	Jefferson	TX	89
13077	Harris	TX	235
13078	Galveston	TX	208
13079	Brazoria	TX	57
13078	Nueces	TX	143
15001	San Diego	CA	77
15003	Los Angeles	CA	295
15011	San Francisco	CA	111
15013	Contra Costa	CA	105
15031	Multnomah	OR	88
15042	King	WA	189
19001	Puerto Rico	PR	91
32013	Madison	IL	88

TABLE 3-8. COASTAL AND WATERWAY COUNTIES HAVING 50 OR MORE[1] HAZARDOUS CHEMICAL SPILLS IN 1973-79, AS RECORDED BY PIRS-USCG (Cont.)

COUNTY #	COUNTY NAME	STATE	NUMBER OF INCIDENTS
33001	Will	IL	54
34024	Jefferson	KY	67
34036	Hamilton	OH	78
34070	Allegheny	PA	84
53034	Cook	IL	61
57066	Wayne	MI	92
57068	Lucas	OH	96

[1] A county with 52 or more incidents has .75% or more of all incidents in the (modified) PIRS file of 6952 incidents.

USCG Districts 1, 3, 5	1633 incidents	24%
USCG Districts 7, 8	1899	28
USCG Districts 11, 12, 13	1415	21
USCG Districts 2, 9	1883	27
TOTAL	6830	100

plus 103 incidents in Puerto Rico and the Virgin Islands.

This distribution shows an almost equal balance among the four major groups. The Western Rivers and Great Lakes (Districts 2 and 9) together have reported almost as many spill incidents as the southern coast, and more than the Northeast or West Coast.

MTB - Geographic Distribution

The MTB-HMIR data provide the primary sources for rail, highway, and air mode incidents in the counties of interest. As discussed previously, it may be hypothesized that a fixed fraction of the spills within a county actually affect the navigable waters, so that the relative distribution but not the absolute number of incidents affecting U.S. waters can be inferred from the MTB spills data. The PIRS data may be taken as a measure of the absolute number of water-based incidents.

Figures 3-8(a) through (d) show the general geographic distribution of the HMIR-MTB spill records. Table 3-9 lists the coastal and waterway counties having 230 or more incidents in 1971-79. The MTB counties correspond well with the PIRS counties;

1. Philadelphia, PA
2. Richmond, VA
3. Wilmington, NC
4. Mobile, AL
5. Erie, PA - Buffalo, NY
6. Cleveland, OH

which are more prominent in the MTB data, and near

1. Corpus Christi, TX

ALL REGULATED CHEMICALS

1971-79 MODE = ALL
CHEM CLASS = ALL # INCIDENTS = 31,515

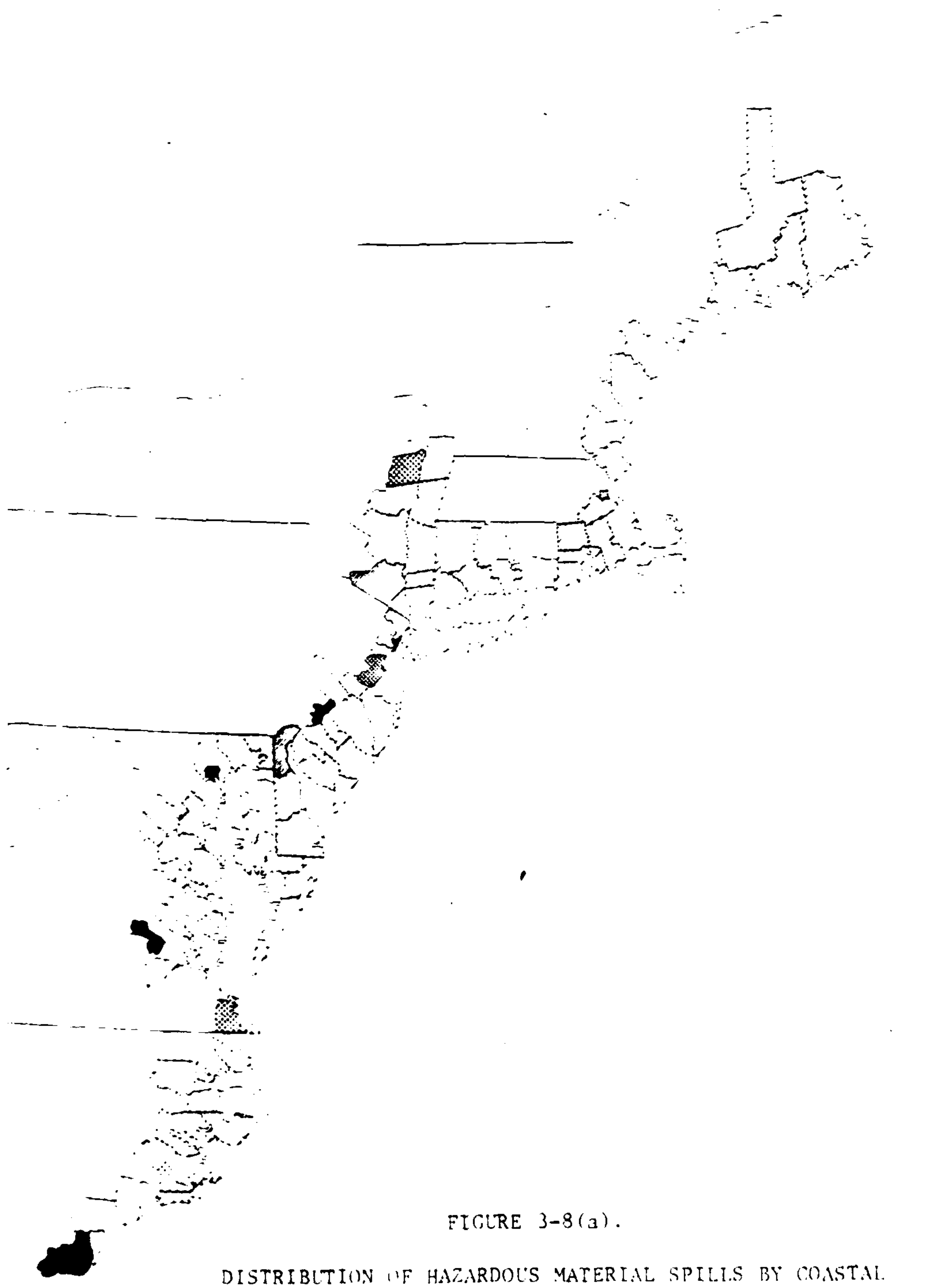


FIGURE 3-8(a).

DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - HMIR, NORTHEAST U.S.

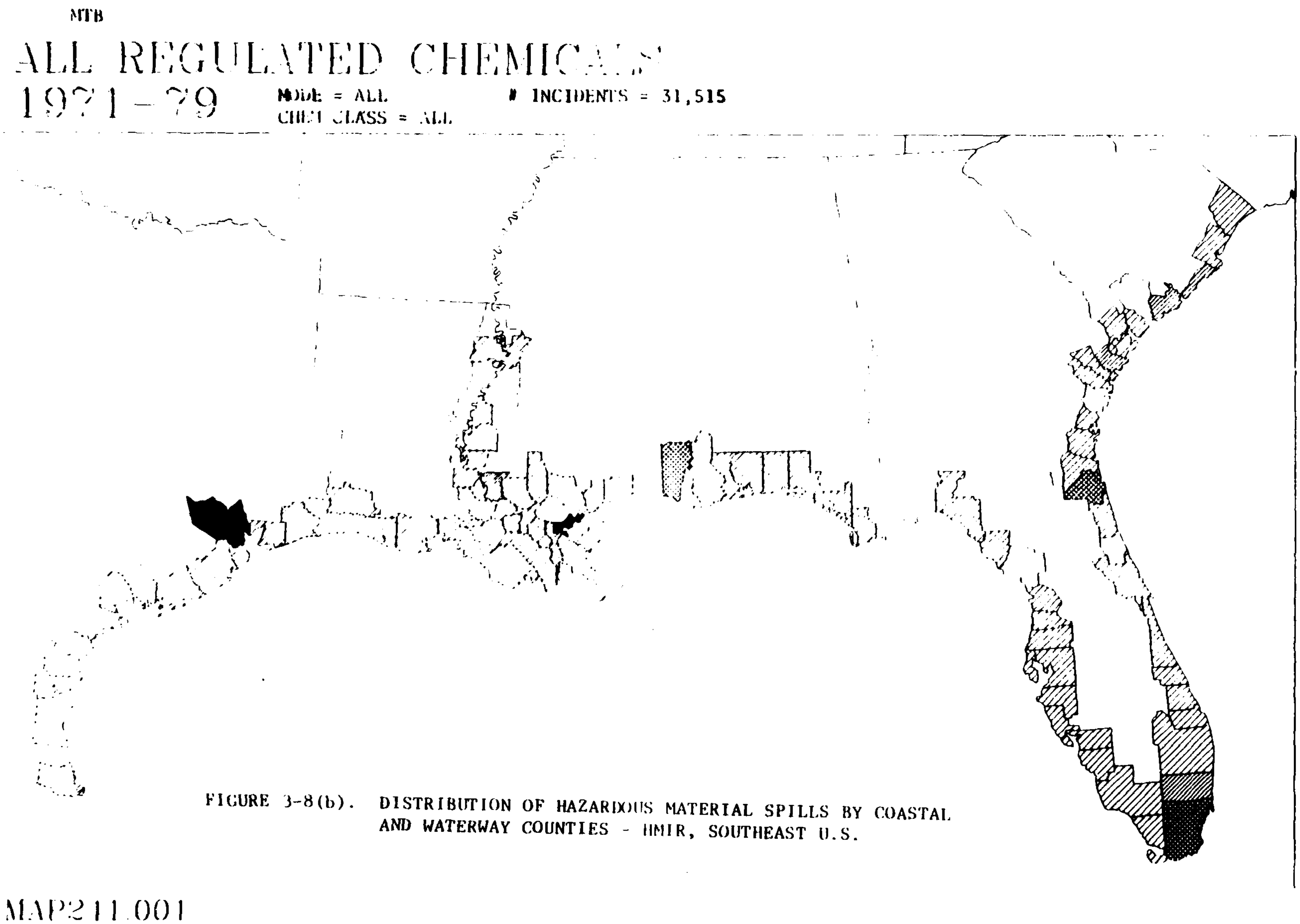


FIGURE 3-8(b). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - HMIR, SOUTHEAST U.S.

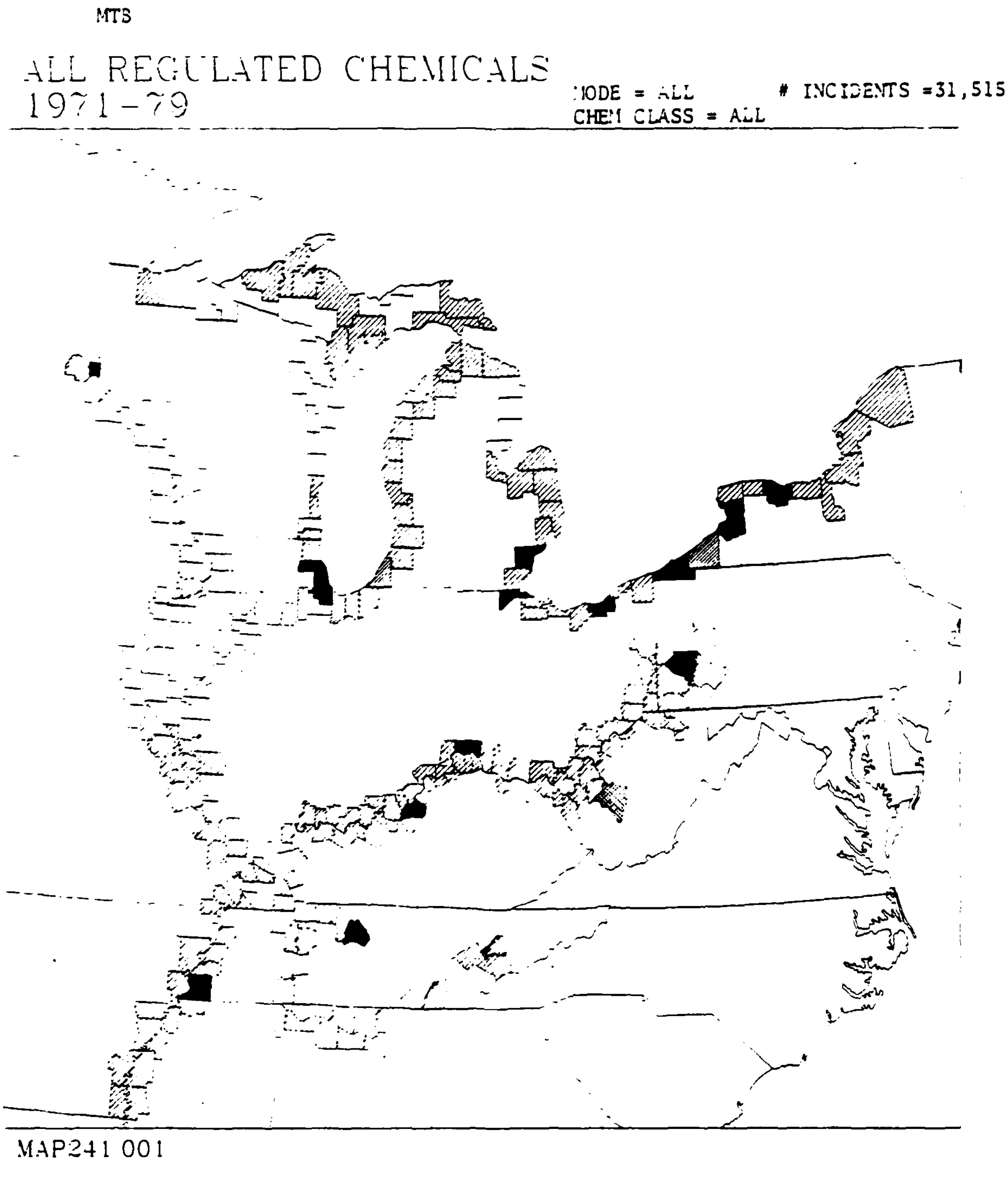


FIGURE 3-8(c). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - HMIR, CENTRAL U.S.

MT3

ALL REGULATED CHEMICALS

1971–79 MODE = ALL # INCIDENTS = 31,515

CHEM CLASS = ALL

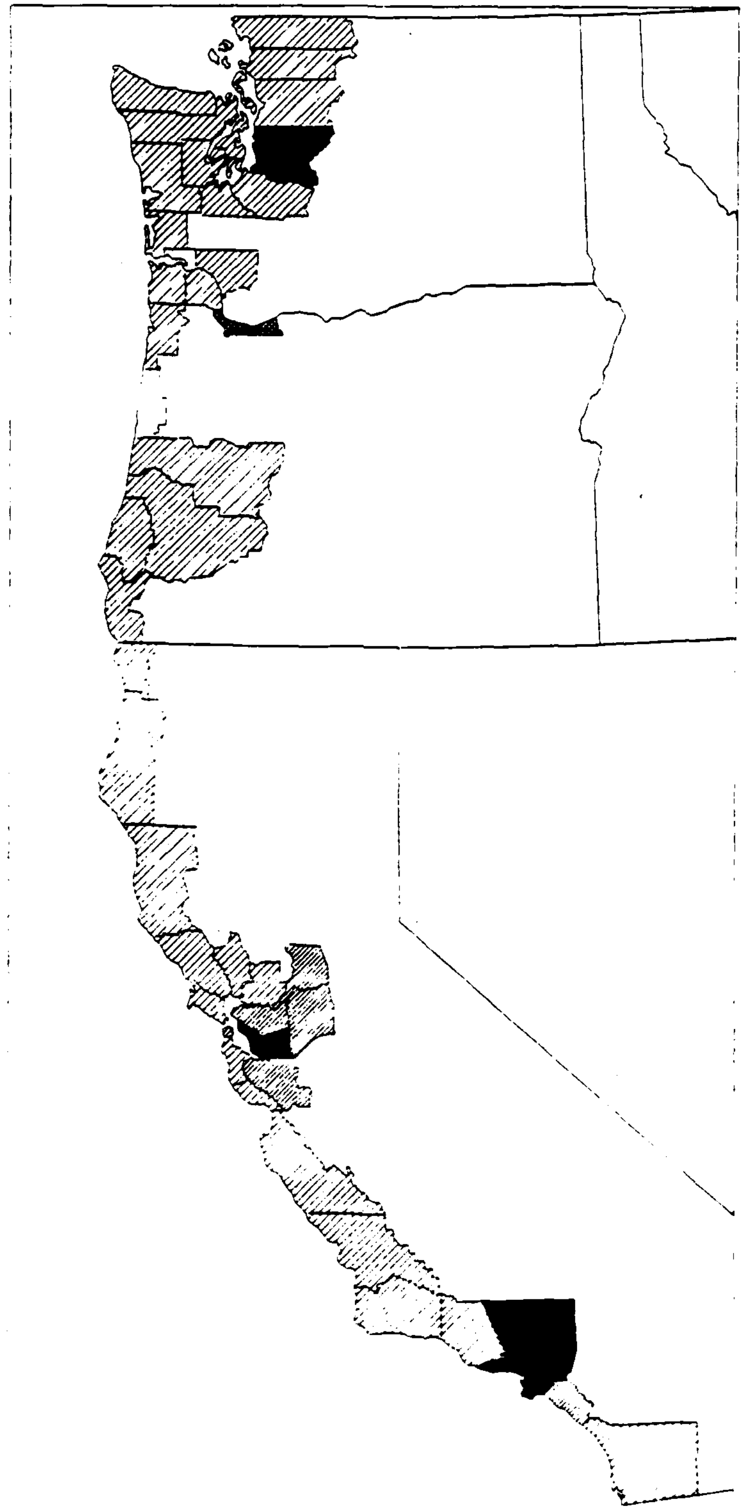


FIGURE 3-8(d). DISTRIBUTION OF HAZARDOUS MATERIAL SPILLS BY COASTAL AND WATERWAY COUNTIES - HMIR, WESTERN U.S.

TABLE 3-9. COASTAL AND WATERWAY COUNTIES HAVING 230 OR MORE[1] HAZARDOUS CHEMICAL SPILLS IN 1971-79, AS RECORDED BY HMIR-MTB

COUNTY #	COUNTY NAME	STATE	NUMBER OF INCIDENTS
11034	Orange	NY	234
11039	Albany	NY	266
11049	Hudson	NJ	475
11052	Middlesex	NJ	349
11063	Philadelphia	PA	476
11080	Baltimore City	MD	599
11108	Henrico	VA	931
11115	Norfolk	VA	306
11138	Brunswick	NC	744
13014	Duval	FL	249
13024	Dade	FL	289
13049	Mobile	AL	249
13064	Orleans	LA	515
13077	Harris	TX	876
15003	Los Angeles	CA	1187
15012	Alameda	CA	418
15031	Multnomah	OR	292
15042	King	WA	330
31023	Shelby	TN	1694
32056	Ramsey	MN	633
32057	Hennipin	MN	232
34024	Jefferson	KY	577
34036	Hamilton	OH	1084

TABLE 3-9. COASTAL AND WATERWAY COUNTIES HAVING 230 OR MORE[1] HAZARDOUS CHEMICAL SPILLS IN 1971-79, AS RECORDED BY HMIR-MTB (Cont.)

COUNTY #	COUNTY NAME	STATE	NUMBER OF INCIDENTS
34070	Allegheny	PA	815
35007	Davidson	TN	710
39002	Kanawha	WV	305
53034	Cook	IL	2185
57066	Wayne	MI	894
57068	Lucas	OH	691
57073	Cuyahoga	OH	827
57076	Erie	PA	485
57078	Erie	NY	752

[1] A county with 232 or more incidents has .75% or more of all incidents in the (modified) MTB file of 31,515.

2. East St. Louis, IL

3. San Diego, CA

which are more prominent in the PIRS than in the MTB data.

When the MTB incidents are broken down by Coast Guard Districts, the result is:

USCG Districts 1, 3, 5	7,526 incidents	24%
USCG Districts 7, 8	3,819	12
USCG Districts 11, 12, 13	3,360	11
USCG Districts 2, 9	16,751	53
TOTAL	31,456	100

plus 59 incidents in Puerto Rico, Hawaii, and the Virgin Islands.

This list provides an informative comparison with the corresponding list for PIRS incidents, above. It shows clearly that a larger percentage of MTB incidents occurred in Districts 2 and 9 than did PIRS incidents, (54% vs. 27%). This may be due to the relatively larger importance of land-based industry in Districts 2 and 9. Another unusual aspect is that Districts 1, 3, and 5 have about the same percentage of incidents (24%) in both reporting systems. An explanation may be that chemical industry and transport in those Districts have a large water-based transport component. The remainder of the country would appear to be balanced between chemical industries that have water-based and land-based transport.

3.5 PROJECTION

The problem of estimating the rate of hazardous chemical spills in the 1980-1985 time frame is important for deployment planning, and has been studied at least since 1973 (Reference 13). Despite the drawbacks of employing chemical production figures as surrogates for hazchem transport exposure (Reference 13, p. 33) it is still necessary to do so, because direct measures of exposure are not generally available even today. Therefore, an attempt was made to correlate chemical production with chemical spills, based on 1971-79 data for both, and to use the results for projection into 1980-90. The results are shown in Figure 3-9 and 3-10.

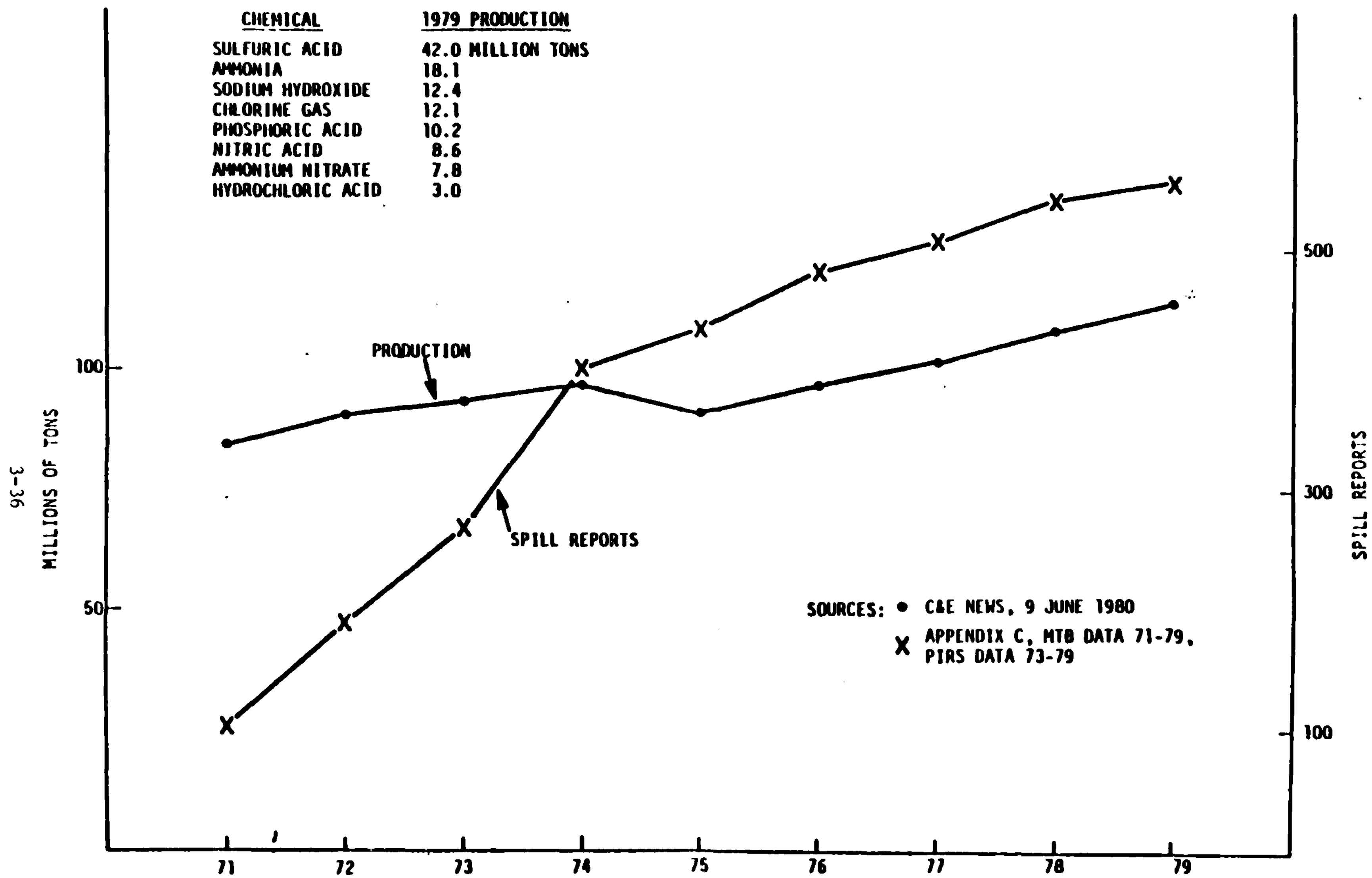


FIGURE 3-9. MAJOR INORGANIC CHEMICAL PRODUCTION AND SPILL REPORTS 1971-79

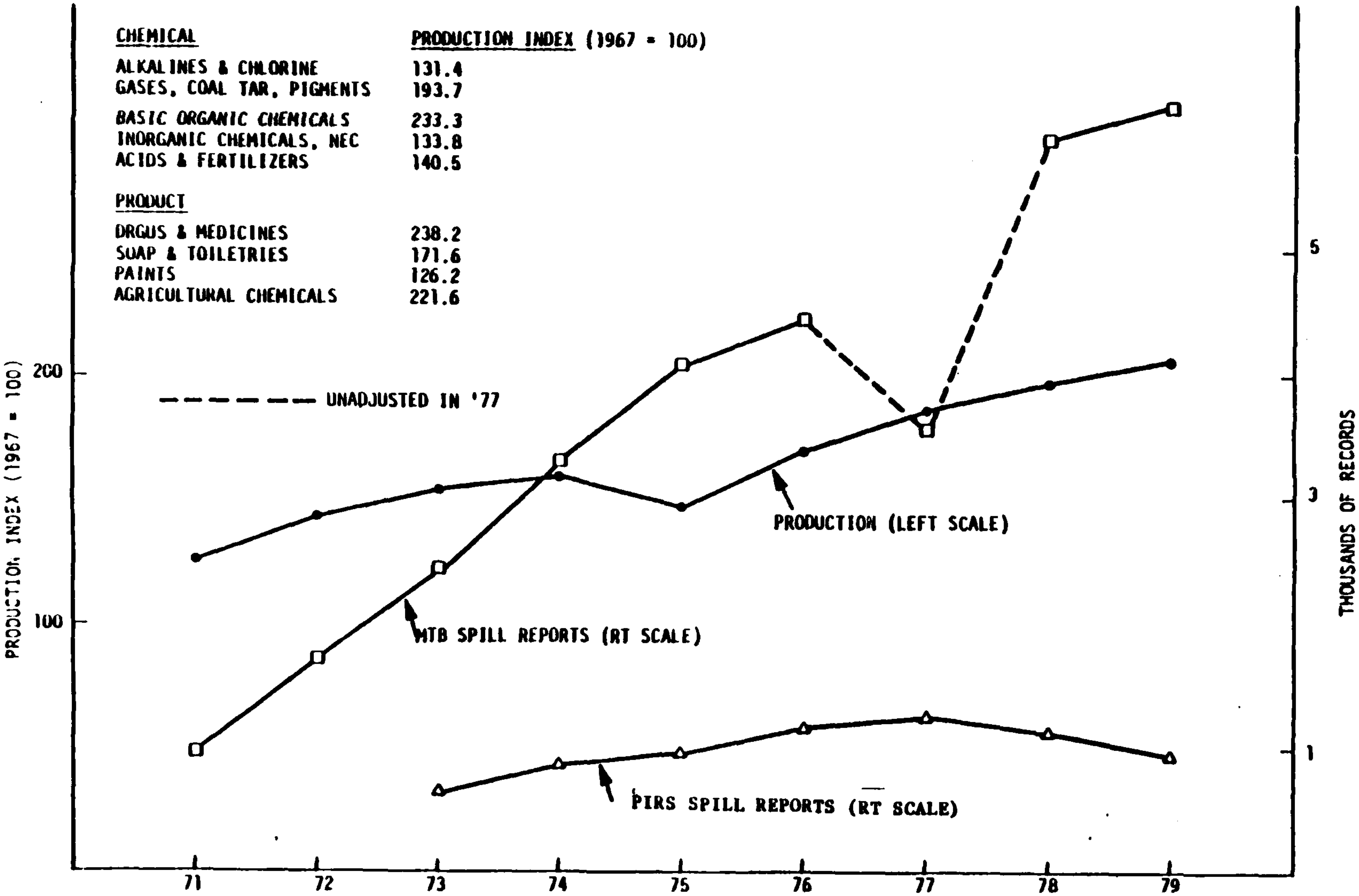


FIGURE 3-10. CHEMICALS AND PRODUCTS, PRODUCTION AND SPILL REPORTS 1971-79

Figure 3-9 is a composite of production and spill data for eight major inorganic chemicals, 1971-79. The spill data are the sums of PIRS and MTB data. It should be noted that the PIRS data commence in 1973. Therefore, the spills shown for 1971 and 1972 are about 10-15 percent lower than if PIRS data for those years had been available. Even when the lack of early PIRS data is allowed for it is seen that the increase in spill reports for the eight chemicals from 1971 to 1974 far exceeds the increase in their production in that time period. This difference may be attributed largely to the increase in compliance with the reporting requirements for MTB spills in the early part of the decade.

From 1974 through 1979, however, the slope of the spill report curve (about 7% per year) moves closer to the slope of the production curve (about 4% per year) than it was prior to 1974. The similarity in the two curves, particularly since 1975, suggests that a stable relation may be developing between production and spill reporting, for the chemicals involved.

Figure 3-10 shows total production of nine groups of chemicals and chemical products, as listed, along with MTB and PIRS spill report data for 1971-79 taken from Figures 3-4 and 3-5. The general trend of production is upward; the best fit straight line has a slope of about 5.7 percent per year (relative to its mid-point). The number of MTB spill records, however, show a very sharp increase (over 5 times the 1971 value), except for the drop in 1977 due to the reporting anomaly discussed earlier. The PIRS records on the other hand increase at an annual rate of about 5.9 percent per year (slope of the best fit straight line, relative to the mid-point). Thus the PIRS data show good over-all agreement with production.

A different picture emerges, however, when the spill incidents are restricted to those to which the Coast Guard is likely to have responded. They were determined by setting certain threshold values for each chemical, as explained in Section 4.2.1.3; below these spill sizes a Coast Guard response is assumed to be unlikely, and above them a Coast Guard response is assumed to be likely. When these incidents only are plotted (Figure 5-4) the total of PIRS and HMIR records is seen to drop by about 8 percent per year from 1977 to 1979, after rising about 17 percent from 1976 to 1977. The two years of data, however, are insufficient to establish a trend.

In summary it can be stated that while both production and total number of spills reported have been increasing at about 4-7 percent in the latter half of the decade, the number of "respondable" spills shows a leveling or declining trend in the last four years.

3.6 SUMMARY

The information and conclusions drawn from the preceding analyses apply to spills of hazardous (non-oil) materials in the coastal and waterway counties of the United States.

Mode

1. The MTB data are representative of highway, rail, and air mode spills; the PIRS data cover water and facility-based spills. There is less than 0.5 percent overlap of the two data sources.

Chemicals

2. There is also poor correlation of the two sources with regard to the types of chemicals reported spilled. This is attributed to (1) differences in the two chemical coding schemes, and (2) differences in the types of chemicals shipped by water as opposed to highway, rail, and air.

3. About 60 percent of the spills reported to MTB, and over 80 percent of the spills reported to PIRS, are flammable liquids.

4. The MTB and the PIRS systems differ in the scope and character of the substances they report (i.e., "hazardous" vs. "polluting"). This difference makes comparison of the chemicals in the two data bases very difficult.

Time History

5. The number of incidents reported to PIRS increased at about 10 percent per year from 1973 through 1977, then declined about 8 percent per year in 1978 and 1979. The MTB reports, on the other hand, show a 26 percent per year increase in number from 1971 through 1978. This rapid increase is attributed to an increase in reporting fraction rather than to an increase in incidents.

6. It was found that while both chemical production and total number of spills reported have increased at about 4-7 percent in the 1975-1980 period the number of spills to which the U.S. Coast Guard is likely to have responded shows a levelling or declining trend in the last four years.

Location

7. Chemical spill incidents are not uniformly distributed along the coast and waterways, but cluster significantly in industrial and population centers. The clustering is independent of chemical group and mode. Some differences in spill concentration exist between the MTB and PIRS data, but the general agreement is good.

8. Incidents reported to PIRS are evenly divided among the four major geographic regions covered: East coast, Gulf coast, West coast, and Western Rivers - Great Lakes. The distribution among Coast Guard Districts shows the largest percentages in District 8 (22%), District 2 (17%) and District 3 (13%). The HMIR data show a greater percentage of spills in the 2nd and 9th Districts than do the PIRS data.

4. U.S. COAST GUARD CHEMICAL SPILL RESPONSE EQUIPMENT TYPES

The preceding Sections of this report have reviewed the non-U.S. Coast Guard chemical spill response capability and estimated the geographic distribution of chemical spills threat to be expected in 1985.

The final step of the basic methodology is carried out in this and the following Section. The present and recommended types of chemical response equipment are treated in this Section. The number and location of the response units are determined in the next Section. It will be seen that, for reasons of mobility and response time, the chemical response equipment assigned to a base should be pre-loaded onto response vehicles. Therefore, the objective of this Section is to describe the mix of equipment to be contained in these vehicles.

4.1 PRESENT COAST GUARD EQUIPMENT TYPES

A sampling of the Coast Guard hazchem response equipment was taken from the SKIM listing. Based on interviews with field personnel, it is evident that the listing was not current as of December 1980, since many equipment items reported from the field are not on the SKIM list. The following SKIM tabulation, therefore, probably underestimates the actual capability:

Item	Number
Self contained breathing apparatus	44
Gas Masks	135
Unspecified type, breathing apparatus	52
Fire Suits	3
Acid Suits	38
pH meters	2
Explosimeters	15
Multiple-gas meters	2
Oxygen sampler	2

These equipments are spread among the three Strike Teams and several MSO's. In addition, some units have one or more chemical response vans. The contents of the vans, however, have not been standardized.

4.2 COAST GUARD COMPLEMENT TO NATIONAL RESPONSE CAPABILITIES

One of the policies underlying the Coast Guard Marine Environmental Response mission is that Coast Guard equipment will only supplement private sector inventories as necessary to respond to emergencies, or will be purchased through R&D efforts to provide equipment where none presently exists. (Reference 6) It is also Coast Guard policy to encourage industry to enhance its own capabilities to prevent or respond to spills.

The purpose of the assessment described in Section 2 was to determine the strengths and weaknesses in national hazchem response capabilities so as to determine the most effective U.S. Coast Guard complement. Because of the limited extent of the data, however, only restricted conclusions can be drawn.

- o EPA has good capability for technical advice, and analytic equipment.
- o Local governments can usually provide firefighting and communications capability.
- o About 60 percent of the total amount of equipment is in the hands of commercial companies (60%).
- o Private organizations have about 33 percent of the total capability and can provide good response for certain products.
- o Governmental capability (Federal, State, Local) is a small fraction (about 8%) of the total national capability.

Considering these results, as well as the basic policy stated above, the following general guidelines have been adopted to aid in the formulation of Coast Guard hazchem equipment deployment requirements:

(1) Minimal analytic laboratory equipment is required of the Coast Guard.

(2) Minimal firefighting equipment is required of the Coast Guard.

(3) Maximum use will be made by the Coast Guard of commercial and private capability.

(4) The response vehicles and teams described here are to be the major USCG response to chemical spills. The MSO is assumed to provide the OSC, and general expertise in chemical cleanup, but would otherwise rely on the response vehicles and teams.

(5) The equipment and capability deployed by the Coast Guard will be for

(a) rapid, but temporary assistance when other sources of response are not available.

(b) protection of Coast Guard personnel on the scene.

(c) initial assessments and monitoring of removal operations.

The guideline 5(a) is significant in that it implies that mobility should be given high priority. The general measure of mobility, of course, is response time, which in turn depends on transport mode. Two approaches are possible: (1) numerous small bases that respond over short distance via highway, and (2) few, relatively large bases that respond via air. Combinations are also possible.

Land response is best achieved by units pre-loaded and dedicated to hazardous chemical spill response. The pre-loaded unit not only saves time and improves preparedness at the initial stages of a response, but also provides storage space for the equipment between responses. The major questions in this approach are the size and contents of the response vehicle, and the numbers of such vehicles at the various bases.

Air response is more limited by cost than is land response. A significant cost saving can be achieved, however, if USCG transport aircarft (C130H, C130B) are employed, since they are normally maintained in a ready status for the Search and Rescue mission.

An ideal arrangement, but one suitable for only some bases, is a set of air-transportable response vans that are located at or near USCG airbase with C130H/B aircraft. These are:

Barber's Point, HI	3-HC-130B
Clearwater, FL	3-HC-130B
Elizabeth City, NC	4-HC-130B
Kodiak, AK	6-HC-130H
Sacramento, CA	4-HC-130H

Because the air-transportable vehicle does not require a greater investment than a similar one that is not air-transportable, it will be assumed that response vans, if employed, are of that type.

The practicality of pre-loading response equipment into an appropriate vehicle depends on the size and type of equipment involved. More than one type of vehicle may be required to hold all the response equipment required for a spill. The chemical spill response equipment under consideration does not include large pieces, because most heavy equipment is associated with long-term, rather than emergency response. Emergency chemical response equipment, in fact, is usually smaller and lighter than emergency oil spill response equipment.

4.2.1 Analysis of Equipment Types

The suitability of various types of chemical spill response equipment for USCG units needs to be ascertained. These equipments fall into five general categories

1. Instrumentation
2. Personal Protection Gear
3. Foaming and Fire Fighting Equipment
4. Offloading Equipment
5. Communication Equipment

4.2.1.1 Instrumentation - USCG requirements for analytic equipment is limited by the emergency nature of their mission. The major need is for portable equipment capable of rapid analysis.

At this time the Coast Guard OSC usually identifies the material released by means of the cargo manifest, bill of lading, or contact with the owner or operator of the source. When these mechanisms fail, he must rely on the resources of local and state response agencies or contract for the services of a commercial laboratory.

Detection of noxious materials in air, water or soil is essential for Coast Guard response teams. Such equipment is available in small, rugged packages and requires only brief familiarization for its use. The major types required are:

(1) pH meters - These are inexpensive devices that determine hydrogen ion concentrations in water, soil or liquids. Many materials have a profound effect on pH values and the extent of contamination can often be detected by these meters.

(2) Sampling meters - Many types are available. They measure levels of methane, ethane, chlorine, hydrogen sulfide. Photo-ionizer units are available that can detect a wide variety of organic compounds and some inorganic compounds. Hydrogen flame ionization meters can detect and measure almost all organic vapors.

(3) Multi-meters - These employ indicator tubes for each chemical to be detected. Although they are not highly accurate they are very flexible and reliable. The utility depends on the number of indicator tubes stocked.

(4) Combustible gas indicator - These measure the level of specific gases in the atmosphere and compare it with known limits to determine the possibility of explosion of the particular air/gas mixture present. Many meters can be adjusted for more than one gas.

(5) Oxygen meter - These measure molecular oxygen in the atmosphere as a function of partial pressure.

4.2.1.2 Personnel Protective Gear (PPG) - This is the largest and, perhaps, most important category for USCG response teams. Even if Coast Guard personnel do not themselves undertake pollutant removal actions, they require protective equipment to conduct the initial assessment of the reported spill, to effectively monitor the corrective measures of the responsible party, if any, and to supervise the efforts of any contractors whom the OSC has hired. Personnel Protective Gear (PPG) falls into two categories: respiratory protection and protective clothing. (Reference 7).

Respiratory Protection

Respiratory protective gear fall into two classes, air-purifying respirators and supplied or self-contained air- or oxygen-breathing apparatus.

(1) Air purifying respirator (gas mask) - A breathing system which supplies breathing air to the user from the ambient atmosphere. Protection is provided by mechanical filters, chemical reactants or

neutralizers, and/or absorbers contained in a small variety of forms. The most effective types cover the entire face (full mask or face mask). The purifying container may be small (cartridge) or large (cannister). The container may be attached directly to the mask (usually limited to the cartridge type for mechanical reasons) or it may be connected by a hose to the container. In the simplest form, the mask may contain only a mechanical filter which provides protection only against particulate matter. The duration of protection afforded the user depends on the size of the purifying container, the concentration of gases present, the exertion level of the user and other factors. Reserve supplies of containers are therefore necessary. Also, the contents of the purifying container must be selected to provide protection against the specific types of chemicals. Finally, the respirator only removes contaminants from the air, it does not supply oxygen. If there is inadequate oxygen in the atmosphere immediately around the user, as may occur when the contaminant concentration is high, or if the oxygen has been removed by fire, these respirators should not be used; more protection is required.

(2) Externally-supplied system - A breathing system which supplies breathing air to the user from an external supply (large tank or compressor) through a long hose, or umbilical. The system consists of the external supply, the supply hose, an air regulator, and a full-face mask, plus the necessary harnesses. This type system theoretically has a unlimited supply of air, so the user's working time is not limited. However, the hose does restrict freedom of movement, and it must be protected against hazards such as burning, cutting, kinking, etc.

(3) Self-contained system - A breathing system which supplies breathing air from a tank. The system consists of an air tank, an air regulator, a full-face mask, connecting hoses, and the harnesses needed to hold the mask, regulator, and tank in the proper positions. Since the tanks of compressed air have a fixed capacity, it is possible for the user to exhaust the air supply. Accordingly, the system includes an alarm to alert the user that he has used most of his available air. Another type of self-countained system, often

referred to as a rebreather, removes the carbon dioxide from the contained air and replaces it with oxygen.

Protective Clothing

Several groups of protective clothing may be defined. The groupings below are based on the type of use to which the clothing is put rather than on the specific materials from which they are constructed. Generally, an adequately equipped response vehicle will have gear of each type.

Standard Protective Gear (splash gear) - A suit made of rubber or polymer exterior or coating over a fabric base. These suits are primarily used by Fire Departments and other agencies concerned with protection against water; these suits offer protection against heat and acid for short periods of time or for light exposures, but not against intense corrosive atmospheres or lethal poisons.

In addition to the suits themselves, numerous auxiliary items are available. These include hoods, goggles, gloves, boots, face masks, coveralls, aprons and hats. All such items are available separately. Although included in the chemical/gas suits described below each separate item should be available because it serves a distinct, single, purpose in many spills. The materials must be selected so as to provide resistance to the spectrum of chemicals likely to be encountered.

Fire Suit - a suit made with an exterior of aluminized-glass or asbestos fabric over other layers of glass, asbestos, or cloth fabrics. The more layers of insulating glass or asbestos fabric, the greater thermal protection afforded the wearer. The inner layer is usually cloth to provide strength to the suit and a non-irritating surface to the wearer. These suits always include a helmet or hood, and fully encapsulate the wearer. Accordingly, breathing apparatus is required. Several types of suits are available, and are classified accordingly to the degree of protection they give the wearer:

Proximity suit - Allows the wearer to come close to a fire; it provides protection against moderate heat and occasional contact with hot surfaces.

Approach suit - Allows the wearer to come very close to a fire; it provides protection against high radiant heat levels for extended periods of time.

Entry suit - Allows the wearer to actually enter a fire; it provides protection against flame, very high radiant heat, and very hot surfaces.

Chemical/Gas Suit - A suit made with a vapor-tight coating or layer of material over a cloth layer. These suits always include a helmet or hood, and fully encapsulate the wearer. Accordingly, breathing apparatus is required.

Because no one exterior vapor-tight coating material is compatible with all types of chemicals, the exterior material must be selected to be compatible with the specific type or class of chemical to be handled. Chemical compatibility will be discussed further below.

Fire/Chemical Suit - A suit which provides protection against both high radiant heat and chemicals. The period of use is usually limited. The outer layers are usually made of aluminized synthetic material and the inner layers always are made of chemical-resistant polymers. These suits always include a helmet or hood, and fully encapsulate the wearer. Accordingly, breathing apparatus is required.

4.2.1.3 PPG Requirements Based on Historic Spill Data - An analysis of MTB and PIRS spill data in the period 1973-1979 was performed in order to determine (a) the types of chemical-resistant materials, (b) the types of equipment, and (c) the number of pieces of equipment, that would have been required to respond to the chemical spills recorded in those data bases. The MTB-HMIR data covered 1976-1979, while the PIRS data covered 1973-1979. The analysis is described in Appendix C; the tabulation of results is given in Appendix C-1.

Chemical Compatibility

One of the problems encountered in the analysis of Appendix C was that of compatibility of chemicals and the materials used in the protective gear. The question of chemical resistance of various materials is neither new nor closed. The U.S. Coast Guard has published guides on chemical compatibility and equipment selection (References 7 and 8). Many manufacturers and chemical handbooks list chemical resistance ratings for specific materials. These ratings are not always consistent or accurate. (See Appendix C.) The area is still under research by NIOSH and EPA. The material selections, therefore, were based on the best available data in each case. For the most part these

data were those available from the chemical manufacturing industry. Nevertheless, in many cases, the assignments were purely judgemental in nature.

Chemical List Bridging

Inconsistency of existing material/chemicals lists was not the only difficulty encountered in this approach. A major problem emerged when the chemicals listed by PIRS were compared with those listed by the MTB. The match was poor. The attempt at 'bridging' these two lists of chemicals to a uniform system of designations, as given in the CHRIS (Chemical Hazard Response Information System) system failed for reasons described in Reference 3 and Appendix C. Therefore the analysis of chemical/material requirements for historic spills was carried out separately on the MTB and PIRS chemicals. The analysis of chemical compatibility was carried out on all materials that appeared in the PIRS spill data from 1973 to 1979 and on all MTB materials that had 10 or more spill records with quantity released data from 1976 through 1979. This resulted in 130 out of the 265 PIRS chemicals and 157 out of more than 1600 MTB chemicals being selected for analysis.

The chemicals selected for analysis were then used to extract the spill frequency and release quantity from the MTB and PIRS spill data bases. Fortunately, it was discovered (Reference 3, Table 22) that the duplication of incidents in the two data bases was less than 0.5 percent, so that the number of incidents involving a given chemical was closely approximated by the sum of the PIRS and MTB records involving that chemical. Further, it was found that the major source of mismatch between the two bases was the use of generic descriptions of chemicals (e.g., "zinc compounds", or "Corrosive Liquid, N.O.S."). In those cases the chemical was treated as the most common chemical among the group of chemicals covered by the designation.

Types and Numbers of Equipment

Each of 157 MTB materials and 130 PIRS materials were examined to determine the type of response equipment and the number of units of equipment required as a function of spill size. The results are tabulated in Appendix C1. This Appendix also shows the material recommended for each piece of equipment for compatibility with the chemical.

The materials and equipment requirements for specific chemicals were applied to actual historic spills from PIRS in 1973 through 1979 and to the

spills from HMIR from 1976 to 1979. Many of the spills recorded in the two systems would not have required Coast Guard equipment response. Many spills were obviously of small enough quantity or of innocuous enough material that the initial Coast Guard investigatory response would have resulted in a decision not to initiate an equipment response. In general, it is assumed that only if more than (nominally) 100 lbs of material was released, or if the material was so noxious as to require protective gear, would Coast Guard equipment be called for. These are termed 'respondable spills' in what follows. The nominal 100 lb level was interpreted for each chemical and is shown as the first non-zero quantity listed under the chemical in Appendix C. In order to obtain an estimate of the historic frequency of spills requiring USCG response gear only those spills were counted in which the quantity spilled equalled or exceeded that quantity. This selection rule yielded a total of 667 spills from PIRS and 491 spills from HMIR that exceeded the threshold set for each chemical. These represent only 9.6 percent of the PIRS records, and 1.5 percent of the MTB records.

The number of 'respondable spills' is tabulated by equipment type in Table 4-1. The equipments most frequently required were

Self-Contained Breathing Apparatus	78% of spills
Full Protective Clothing - Neoprene	57% of spills
Rubber Gloves* - Neoprene	18% of spills
Rubber Boots* - Neoprene	17% of spills
Face Shield*	11% of spills

Among the six chemical-resistant materials considered for clothing, gloves and boots, neoprene was by a large margin required most frequently (1059 cases) followed by fluoroelastomer (143 cases) and Butyl Rubber (116 cases).

Another view of response requirements was obtained by listing the PIRS and HMIR chemicals in order of frequency of spill (Reference 3, Tables 17 and 18) with the nature of the hazard they present shown next to each. This list is given in Tables 4-2 and 4-3. The hazard classification system employed is

*But not full protective clothing.

TABLE 4-1. NUMBER OF SPILLS ABOVE RESPONSE THRESHOLD
TABULATED BY EQUIPMENT TYPE

	PIRS 73-79	HMIR 76-79	Total	% of Spills
A1 SCBA (self-contained breathing apparatus)	587	320	907	78.32
A2 SCBA - for high concentration	0	6	6	.52
A3 SCBA - PLASTIC LENS	0	6	6	.52
B1 CANISTER - ALL PURPOSE	9	7	16	1.38
C1 CANISTER - ORGANIC	18	51	69	5.96
D1 CANISTER - AMMONIA (ALKALI)	0	7	7	.60
E1 CANISTER - CHLORINE	0	2	2	.17
F1 CANISTER - ACID	4	11	15	1.30
G1 DUST MASK	33	63	96	8.29
H1 CHEMICAL GOGGLES	39	72	111	9.59
I1 FACE SHIELD	79	45	124	10.71
J1 ALL RUBBER CLOTHING - NEOPRENE	539	119	658	56.82
J2 " " " - BUTYL RUBBER	38	52	90	7.77
J3 " " " - EPR	2	6	8	.69
J4 " " " - HYPALON	8	16	24	2.07
J5 " " " - BUTADIENE	-	-	-	-
J6 " " " - FLUORO-ELASTOMER	9	45	54	4.66
K1 RUBBER GLOVES - NEOPRENE	20	183	203	17.53
K2 " " - BUTYL RUBBER	3	16	19	1.64
K3 " " - EPR	2	8	10	.86
K4 " " - HYPALON	0	8	8	.69
K5 " " - BUTADIENE	-	-	-	-
K6 " " - FLUORO-ELASTOMER	20	26	46	3.97
L1 RUBBER BOOTS - NEOPRENE	18	180	198	17.10
L2 " " - BUTYL RUBBER	3	4	7	.60
L3 " " - EPR	2	1	2	.26
L4 " " - HYPALON	0	0	0	.00
L5 " " - BUTADIENE	-	-	-	-
L6 " " - FLUORO-ELASTOMER	20	23	43	3.71
M1 RUBBER HOOD - NEOPRENE	0	0	0	.00
M6 " " - FLUORO-ELASTOMER	12	0	12	1.04
O1 CORROSIVE	123	135	258	22.28
	667	491	1158	

that devised by the National Fire Protection Association (Reference 10). This system assigns an integer 0 through 4 to health hazard (H), fire hazard (F) and to reactivity (R) of each chemical. A brief description of each level is given in Reference 11. Tables 4-2 and 4-3 also show codes to indicate five major hazards:

FG = gives off flammable or explosive gas

TG = gives off toxic gas

TGF = gives off toxic gas from fire

P_p = pesticide or poison

EX = explosive

These four hazards present particular problems for personnel protection, because the area affected may be very extensive, extending up to 1/2 mile or more from the source. The most frequently encountered of these chemicals, historically, have been:

PIRS	MTB
Lacquer Based Paint	Paint, Enamel, Lacquer, Stain
LPG	Hydrochloric Acid
Hydrochloric Acid	Poisonous Liquid, N.O.S.
Ammonia	LPG
Oil-Based Pesticides	Nitric Acid
Ammonium Compounds	Anhydrous Ammonia
Chlorine	Liquid Insecticide
Acrylonitrite	Compressed Gas N.O.S. (FG)
Nitric Acid	Comp. Tree and Weed Killer
Vinyl Acetate	Insecticide Liq. (FL)

Of significance in this list are those chemicals that give off toxic gases in fire (TGF). While hydrocarbons are 'clean-burning', i.e., give off carbon dioxide, carbon, and water, the TGF group gives off more noxious gases, small quantities of which present a health hazard.

TABLE 4-2. MOST FREQUENTLY SPILLED CHEMICALS AND THEIR HAZARD CLASSIFICATIONS AS REPORTED TO PIRS, 1973-1979.

	%	H	F	R	
1. Gasoline	45.7	1	3	0	
2. Hydraulic Fluid	12.5	-	-	-	
3. "Other Hazardous Substances"	5.9	-	-	-	
4. Lacquer-based paint	4.8	1	2	0	TGF
5. Natural gasoline	3.6	1	3	0	
6. Vegetable oil	3.2	0	1	0	
7. Animal oil	2.3	0	1	0	
8. Naptha	1.7	2	3	0	
9. Other petroleum solvent	1.6	-	-	-	
10. Xylene	1.5	2	3	0	
11. LPG	1.3	1	4	0	FG
12. Benzene	1.3	2	3	0	
13. Toluene	1.3	2	3	0	
14. Styrene	1.3	2	3	2	
15. Sulphuric Acid	1.2	3	0	2	
16. Industrial Waste	1.1	-	-	-	
17. Caustic Soda	.80	3	0	1	
18. Hydrochloric Acid	.66	3	0	0	TG
19. Chemical Waste	.66	-	-	-	
20. Mineral Spirits	.65	-	-	-	
21. Paraffin Wax	.56	0	1	0	
22. Cresol	.42	3	2	0	
23. Napthalene	.30	2	2	0	
24. Ammonia	.21	2	1	0	TG
25. Phosphoric Acid	.29	2	0	0	
26. Oil-based pesticides (1)	.27	3	1	0	PP,TGF
27. Phenol (Carbolic Acid)	.26	3	2	0	
28. Sodium Hydroxide	.26	3	0	1	
29. Cyclohexane	.22	1	3	0	
30. Ammonium Compounds (2)	.20	2	0	3	TGF,EX
31. Turpentine	.19	1	3	0	
32. Isopropyl Alcohol	.14	1	3	0	
33. Methyl Alcohol	.14	1	3	0	
34. Chlorine	.14	3	0	0	TG
35. Acetic Acid	.13	2	2	1	
36. Acetone	.11	1	3	0	
37. Acrylonitrile	.10	4	3	2	TG,TGF
38. Glycol	.10	1	1	0	
39. Ethylene Glycol	.10	1	1	0	
40. Perchloro ethylene	.10	2	0	0	
41. Calcium Compounds	.10	-	-	-	
42. Copper Compounds	.10	-	-	-	
43. Methyl Ethyl Ketone	.09	1	3	0	
44. Nitric Acid	.09	3	0	0	TG
45. Vinyl Acetate	.09	2	3	2	FG
46. Chromium Compounds	.09	-	-	-	
47. Oleum	.07	3	0	2	
48. Lead Compounds	.07	-	-	-	

TABLE 4-2. MOST FREQUENTLY SPILLED CHEMICALS AND THEIR HAZARD CLASSIFICATIONS AS REPORTED TO PIRS, 1973-1979 (CONTINUED)

	%	H	F	R	
49. Zinc Compounds	.07	-	-	-	
50. Carbon Tetrachloride	.06	3	0	0	TGF
51. Ethyl Acrylate	.06	2	3	2	
52. Ethyl Alcohol	.06	0	3	0	
53. Trichloroethylene	.06	3	0	0	TGF
54. Cyanide Compounds	.06	3	0	0	FG,PP,TG,TGF
55. Ethyl Benzene	.06	2	3	0	
56. Acetic Anhydride	.04	2	2	1	
57. Acrylic Acid	.04	3	2	2	
58. Bromine	.04	4	0	0	TG
59. Methyl Iso-Butyl Ketone	.04	2	3	0	
60. Methyl Methacrylate	.04	2	3	2	
61. Aluminum Sulfite	.04	-	-	-	
62. Chlordane	.04	-	-	-	PP
63. PCB	.04	-	-	-	
64. Potassium Permaganate	.04	1	0	0	
65. Toxaphene	.04	4	3	0	
66. Acetaldehyde	.03	2	4	2	
67. Allyl Alcohol	.03	3	3	0	
68. n-Butyl Acrylate	.03	2	2	2	
69. n-Butyl Alcohol	.03	1	3	0	
70. n-Butyraldehyde	.03	2	3	0	
71. Chloroform	.03	2	0	0	TGF
72. Dichloropropane	.03	2	0	0	TGF
73. Ethylene Diamene	.03	3	2	0	
74. Formaldehyde	.03	2	4	0	TG
75. Hydrogen Peroxide >60%	.03	2	0	3	
76. n-Propyl Alcohol	.03	2	3	0	
77. Trichloroethane	.03	2	1	0	TGF
78. Vinylidene Chloride	.03	2	4	2	FG
79. Iron Compounds	.03	-	-	-	
80. Maleic Acid	.03	3	1	1	
81. Nitrogen Dioxide	.03	3	0	0	TG
82. Parathion	.03	4	1	2	PP
83. Pentachloro phenol	.03	3	2	0	TGF
84. Propionic Acid	.03	2	2	0	
85. Sodium Hypochlorite	.03	1	0	0	
86. Sulfur Monochloride	.03	2	1	1	TG
87. Xylenol	.03	3	2	0	
88. Acetone Cyanohydrin	.03	4	1	2	TGF
89. Acetonitrile	.01	2	3	0	TG,TGF
90. n-Amyl Alcohol	.01	1	3	0	
91. n-butyl Acetate	.01	1	3	0	
92. Butyl ether	.01	2	3	0	
93. Butyric Acid	.01	-	-	-	
94. Dimethylamine, 40%	.01	3	4	0	FG,TG
95. Epichlorohydrin	.01	3	3	2	TGF
96. Ethyl Acetate	.01	1	3	0	

TABLE 4-2. MOST FREQUENTLY SPILLED CHEMICALS AND THEIR HAZARD CLASSIFICATIONS AS REPORTED TO PIRS, 1973-1979 (CONTINUED)

	%	H	F	R	
97. Ethylene Cyanohydrin	.01	2	1	1	TGF
98. Glycerin	.01	-	-	-	
99. n-Hexane	.01	1	3	0	
100. Hydroflouric Acid	.01	4	0	0	TG
101. Isoprene	.01	2	4	2	
102. Methyl Acrylate	.01	2	3	2	
103. Propylene Oxide	.01	2	4	2	FG
104. Tetraethyl Lead	.01	3	2	3	
105. Butylamine	.01	2	3	0	
106. Flourine Compounds	.01	-	-	-	TG,TGF
107. Methyl Parathion	.01	4	3	2	PP
108. Phosphorous Trichloride	.01	3	0	2	TG
109. Sodium Bisulfite	.01	3	1	2	TGF
110. Sodium Hydrosulfide	.01	-	-	-	
111. Sodium Nitrite	.01	-	-	-	
112. Sodium Phosphate, Monobasic	.01	-	-	-	
113. Sodium Sulfide	.01	2	1	0	TGF
114. Strychnine	.01	-	-	-	PP
115. Uranium Compounds	.01	-	-	-	
	100.00				

NOTES:

✓ indicates that the material or group of materials can present one or more of the following hazards:

FG = gives off flammable or explosive gas

TG = gives off toxic gas

TGF = gives off toxic gas when on fire

EX = Class A or B explosive

PP = pesticide or poison

% indicates the percentage of incidents involving the listed material from among the 6964 incidents extracted from the PIRS data base, 1973-79.

(1) Endrin, in solution, taken as typical.
(2) Ammonium Nitrate taken as typical.
(3) Sodium Cyanide taken as typical.

TABLE 4-3. FIFTY MOST FREQUENTLY SPILLED CHEMICALS AND THEIR HAZARD CLASSIFICATIONS AS REPORTED TO MTB, 1971-1979.

	%	H	F	R	
1. Paint, Enamel, Lacquer, Stain	22.0	1	2	0	TGF
2. Gasoline	8.9	1	3	0	
3. Comp. Cleaning Liquid	7.2	-	-	-	
4. Corrosive Liquid N.O.S.	4.5	-	-	-	
5. Flammable Liquid N.O.S.	4.5	-	-	-	
6. Comp. Paint Remover	4.3	-	-	-	
7. Sulfuric Acid	3.3	3	0	2	
8. Cement Liquid N.O.S.	3.1	-	-	-	
9. Hydrochloric Acid	2.0	-	-	-	TG
10. Resin Solution	2.1	-	-	-	
11. Electric Battery Fluid	1.6	-	-	-	
12. Ink	1.4	-	-	-	
13. Alcohol N.O.S.	1.3	-	-	-	
14. Poisonous Liquid N.O.S.	1.3	-	-	-	PP
15. Liquid Petroleum Gas	1.0	1	4	0	FG
16. Acid Liquid N.O.S.	.84	-	-	-	
17. Combustible Liquid N.O.S.	.77	-	-	-	
18. Nitric Acid	.73	3	0	0	TG
19. Phosphoric Acid	.71	2	0	0	
20. Anhydrous Ammonia	.68	2	1	0	TG
21. Comp. Cleaning Liq. F	.64	-	-	-	
22. Corrosive Solid N.O.S.	.64	-	-	-	
23. Solvents N.O.S.	.61	-	-	-	
24. Insecticide Liquid	.61	-	-	-	PP
25. Sodium Hydroxide	.60	3	0	1	
26. Methyl Alcohol	.60	1	3	0	
27. Caustic Soda Liq.	.53	3	0	1	
28. Compressed Gases N.O.S. (FG)	.49	-	-	-	FG
29. Comp. Rust Remover	.43	-	-	-	
30. Acetone	.42	1	3	0	
31. Xylene (Xylol)	.41	2	3	0	
32. Toluene	.30	2	3	0	
33. Petroleum Naptha	.37	2	3	0	
34. Comp. Tree & Weed Killer	.36	-	-	-	PP
35. Boiler Compound Liq.	.36	-	-	-	
36. Comp. Paint Remover	.32	-	-	-	
37. Insecticide Liq. (FL)	.31	-	-	-	PP,TGF
38. Drugs Chemicals Cor.	.31	-	-	-	
39. Alkaline Liq. N.O.S.	.31	-	-	-	
40. Nitric Acid <40%	.28	-	-	-	
41. Oxi Material N.O.S.	.28	-	-	-	
42. Compr. gases N.O.S. (NFG)	.27	-	-	-	
43. Comp. Tree & Weed Killer (FL)	.26	-	-	-	PP,TGF
44. Water Treat Comp.	.26	-	-	-	TGF
45. Carbolic Acid Liq.	.25	3	2	0	
46. Hypochlorite Sol	.24	-	-	-	TGF
47. Hydroflouric Acid Sln	.24	4	0	0	TG
48. Oil N.O.S.	.23	2	0	2	
49. Ammonium Hydroxide <45	.23	2	0	2	TG
50. Hydrogen Peroxide	.23	2	0	3	
	85.2				

TABLE 4-3. FIFTY MOST FREQUENTLY SPILLED CHEMICALS AND THEIR HAZARD CLASSIFICATIONS AS REPORTED TO MTB, 1971-1979 (CONTINUED)

NOTES:

✓ indicates that the material or group of materials can present one or more of the following hazards:

FG = gives off flammable or explosive gas

TG = gives off toxic gas

TGF = gives off toxic gas when on fire

EX = Class A or B explosive

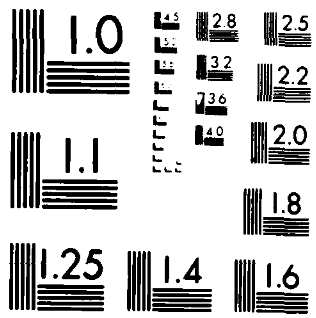
PP = pesticide or poison

% indicates the percentage of incidents involving the listed material from among the 31,515 incidents extracted from the MTB data base, 1971-79.

(1) Endrin, in solution, taken as typical.
(2) Ammonium Nitrate taken as typical.
(3) Sodium Cyanide taken as typical.

AD-A123 075 US COAST GUARD EQUIPMENT DEPLOYMENT REQUIREMENTS FOR HAZARDOUS CHEMICAL S..(U) TRANSPORTATION SYSTEMS CENTER CAMBRIDGE MA RESEARCH AND SPECI.. J BELLANTONI ET AL. 2/3

UNCLASSIFIED NOV 82 DOT-TSC-USCG-82-1 USCG-W-001-82 F/G 7/0 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

4.2.1.4 Foaming and Fire Fighting Equipment - The guidelines stated previously call for minimal firefighting equipment for U.S. Coast Guard response units. The reason is that local fire-fighting units usually are equipped for both foaming and fire-fighting. Although the adequacy of these systems at the local level may be questioned, particularly for marine fires (Reference 9, page 35), it is doubtful if Coast Guard resources can make any substantial improvement in their availability for hazardous chemical fires.

The use of foaming systems to prevent ignition of flammable liquids, to retard vaporization of volatile noxious chemicals and to reduce the likelihood of ignition of vapor has not yet been fully researched for many hazardous chemicals (Reference 12). The major area of interest for emergency response is the development of portable equipment that can be employed on a large variety of chemicals, both liquid and solid, to prevent or retard vaporization or reaction with components of the atmosphere. The applicability of the technique depends upon the vapor pressure of the chemical and its reactivity with the foam. The government (USCG and EPA) interest in this development is probably unique because most manufacturers and associations have to deal with only a limited number of chemicals. Until broad-spectrum foams have been developed, however, their use in Coast Guard response inventories will be limited.

4.2.1.5 Offloading Equipment - The estimate of total national response capabilities, Table 2-7, shows about 300 chemical compatible pumps available to the U.S. Coast Guard from all sources in the United States. The actual number may easily be twice that figure, because of errors in the estimating procedure. Further, there is a large supply of chemical-compatible vacuum trucks available from a few firms in the county, most of which are outfitted with pumps. These trucks can provide offloading for highway and rail incidents in 1 to 2 hours from request in most parts of the country. The major area for Coast Guard response in such cases is provision of an up-to-date list of such firms in the local area, including names and telephone numbers for emergency.

In the case of vessel incidents, the need for Coast Guard offloading equipment is also limited, with some exceptions. Incidents in loading and unloading areas are likely to be serviced by offloading equipment available at the terminal. If the ship's pumps are disabled, offloading can often be

accomplished by another vessel, or by terminal auxiliary pumps.

In some cases of marine incidents involving hazardous materials, however, Coast Guard offloading capability may be of use. These are cases of bulk shipments of chemicals in barges (as opposed to barge shipments of chemicals in special containers or tanks). Products such as sulphuric acid, liquid fertilizer, and pesticides are commonly shipped in bulk. Conventional offloading equipment, such as steel pumps, are subject to corrosion and/or fouling by these materials; stainless steel pumps or teflon or polyethylene-lined pumps are required depending on the substance. In the event that operative pumps are not available on the barge involved and barge-mounted pumping/vacuum tank equipment cannot reach the scene rapidly, Coast Guard unloading or transfer of bulk chemicals may be necessary.

The acquisition and deployment by the Coast Guard of chemical vacuum trucks and/or truck-mounted tanks is not necessary because of the large supply of such vehicles available from chemical transport firms, such as Chemical Leahman, Inc. or Matlack, Inc. (See Section 2.) Coast Guard resources expended on this type equipment would have a low effectiveness/cost ratio because of their high cost and low utilization by the Coast Guard. The same is true of chemical barges and barge-mounted chemical tanks. Chemical-compatible overpack drums, however, are relatively inexpensive and of potential utility for small quantity releases.

4.2.1.6 Communication Equipment - Although access to extensive communication networks are usually available through local police and fire departments, Coast Guard participation in a response action should not place additional loads on such networks. In addition, response to vessel incidents may involve only Coast Guard resources.

The communication facilities employed by the Coast Guard for oil pollution response are adequate for chemical spill response with the exception of communication with and between personnel in helmetted or encapsulated suits. This can be provided by a number of types of headsets, including microphone and transmitter, since the distances involved are usually under 1000 feet.

4.2.2 Analysis of a Response Mission

The equipment requirements for Coast Guard response to a hazardous material spill will depend on the role the Coast Guard is called on to fill as well as the nature of the incident.

The Coast Guard role is assumed to be that of (1) investigating the source, nature and extent of the hazard or pollution, (2) sampling air, surface and water to determine chemical components and concentrations, (3) monitoring the cleanup and control actions of the spiller, contractors, or other agencies, and (4) carrying out cleanup and abatement actions, but only in cases in which spiller and contractor actions are inadequate. Since the assessment of non-Coast Guard resources showed that adequate quantities of most types of equipment are available for land spills from commercial and private sources, the primary role of Coast Guard-owned equipment is that of rapid response, i.e., providing assistance in the first few hours of an incident, before other equipment can be mobilized. A second role is that of response to vessel-related incidents, where commercial and private capabilities are inadequate or slow to arrive.

Generally, four different levels of Coast Guard response to a land spill can be distinguished: (1) In the simplest case, only the local Marine Safety Office (MSO) is involved. Preliminary investigation by the MSO reveals that Coast Guard special capability, beyond that available at the MSO, is not required. (2) Limited response; no USCG equipment is required beyond basic portable equipment such as respirators, boots, instrumentation, etc.; full protective clothing is not needed; 3-6 persons are dispatched with equipment via private aircraft, commercial airline, or station wagon. (3) Full 10-man response, requiring chemical response van. (4) Full 20-man response, requiring chemical response van. The typical full 10- or 20-man chemical spill response from a Coast Guard base to a non-vessel spill has clear implications for the equipment.

1. The team will usually respond to a request by the On-Scene Coordinator (OSC). The request may be for specific capability, or for general assistance. In most cases, rapid response is essential. This implies that the equipment must be pre-selected and ready for use on a response van. It is desirable to minimize the number of different types of response vehicles required, so as to simplify the initial decision process, and so as to provide the greatest degree of flexibility.

2. The request may be for back-up of a previous response, i.e., it may be intended to augment USCG forces already on scene from the same or from another base. If it is to support another base's response, the distance to the scene may be considerable. For this reason, the response vehicles should be air transportable via USCG C130B aircraft or larger.

3. The identification of the chemicals involved will probably have been made before departure from the base or before arrival at the scene. One of the first tasks will probably be determination of the physical location and concentration of contaminants, by samples of soil, air and water. This is likely to be a continued operation that the response team will carry out throughout the mission.

4. Upon determination of the general extent and nature of the hazard, and its possible evolution, personnel protection gear will be selected. The nature of protection will be dependent on the hazard level and on the distance from the source(s), as follows:

Level 1 hazard - This is the lowest level of hazard requiring protective clothing: coveralls, gloves, boots, goggles, or face shield. Respiratory protection is afforded by dust or gas masks.

Level 2 hazard - This is typically the level of protection required for corrosive material spills. The suits must provide full protection against skin and face contact. This level required an acid-resistant splash suit, with overlapping fabric on coveralls. If a hood is employed it may be necessary to use SCBA (Self-Contained Breathing Apparatus) or externally supplied air systems.

Level 3 hazard - This is the most serious hazard level. Both respiratory and cutaneous protection are required. It is typically encountered when the material produces a poisonous or noxious gas. It calls for full body protection by heavily overlapped clothing or by an encapsulating suit, plus SCBA or an externally supplied air system.

5. The second consideration in determining personnel protection requirements is distance from the hazard source. Account must be taken of wind conditions. Typically, four zones can be distinguished:

Hot Zone - The immediate proximity to the hazard, presenting the greatest danger. In a Level 3 incident, the hot zone will be entered only by personnel in full protective clothing, including SCBA or supplied air systems. Entry will be made in pairs. Coast Guard personnel involved in the hot zone will commonly have one of three missions:

(a) Surveillance, i.e., an exploratory mission to determine the nature of the hazard, gather information, and to monitor the cleanup actions of the responsible party or contractors.

(b) Shut-off, abatement, or repair, i.e., an attempt to close a valve, plug a hole, remove a potentially dangerous container, etc.

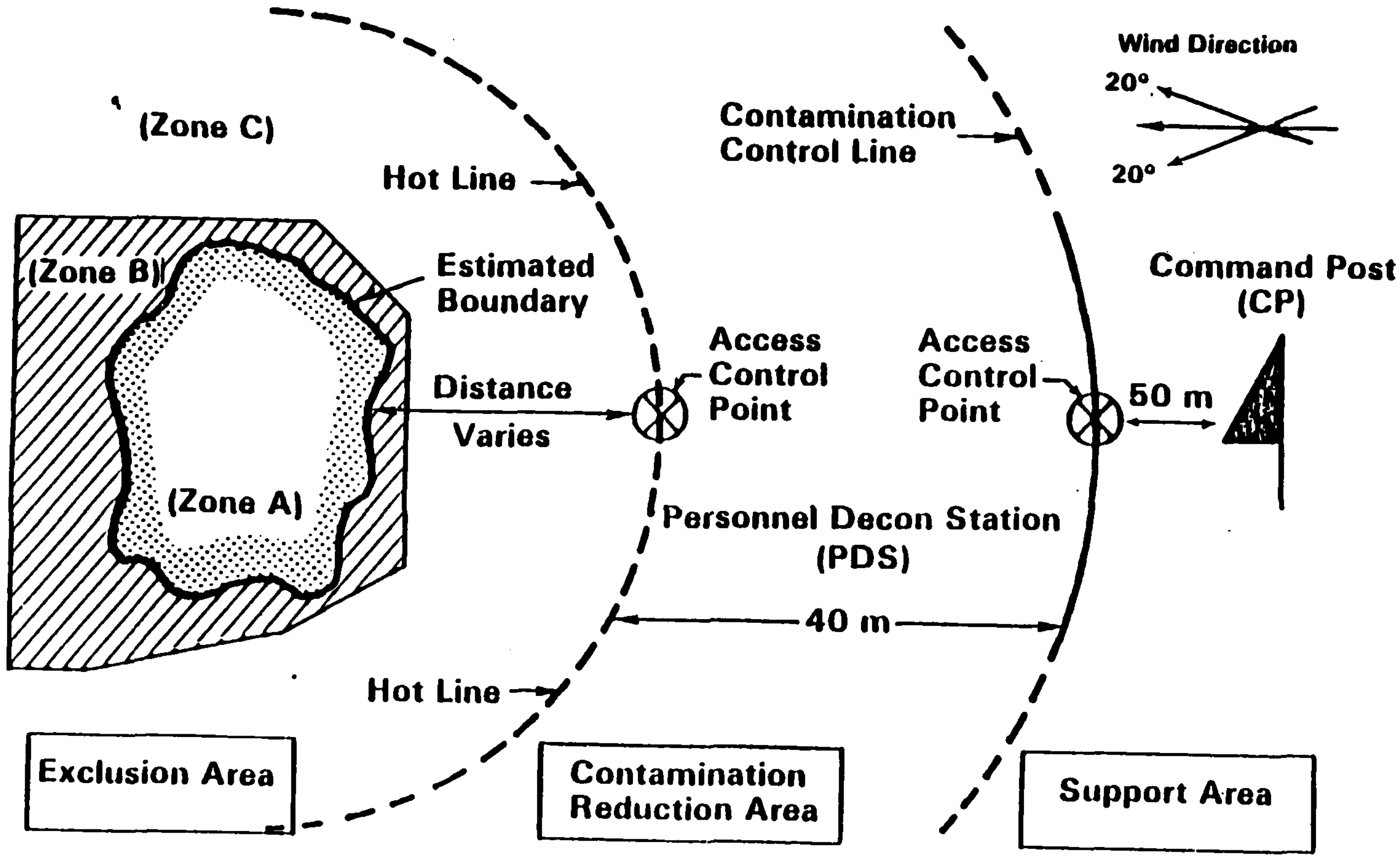
In most cases these missions can be accomplished by one or two pairs, i.e., two or four persons within the hot zone line. As shown in Figure 4-1 three subzones may be distinguished within the hot line: Zone A, the source itself; Zone B, the area containing the source and to which the source has or can immediately spread; and Zone C, the area in danger due to wind shifts, fire, explosions, etc.

DECON Zone - This zone surrounds the hot Zone and contains rescue and support personnel for those in the hot Zone. They will ordinarily have standard protective gear, but will maintain rescue supplies and the fully encapsuled suits. The DECON Zone is used for suit-up and suit-down operations, and contains showers, eye-wash and other decontamination equipment.

Support Zone - The remainder of support and supervisory personnel and equipment are restricted to the support zone. Typically, this zone will contain medical emergency personnel and equipment, time-keepers, and communications back-up equipment, as well as replacements for DECON personnel and instrumentation operators.

6. Patching, plugging and repair will normally be performed only when simple caulking or plugging will suffice. Welding and repair will normally be performed by contractors, as will offloading.

In the event of a vessel spill the segregation of zones may be modified but the equipment requirements will be similar. Standard diving equipment can be employed if water tests indicate low enough concentrations of the chemicals. If concentrations exceed the capability of standard diving suit fabric, then contractor assistance must be relied on to perform diving tasks.



NOTE: Zone dimensions are for illustration purposes only.
Zone dimensions will vary on a case-per-case basis.

FIGURE 4-1. HAZARDOUS MATERIAL SPILL SITE WORK AREAS

The minimum number of personnel required for a mission is estimated as follows for a Level 3 spill as a function of spill size.

	MAJOR	MEDIUM OR MINOR
Hot Zone, fully suited	4	2
DECON Zone, rescue, with suits	2	1
DECON Zone, decon operations	2	1
Support Zone, command	4	2
Hot Zone Relier Crew #1	4	2
Hot Zone Relief Crew #2	4	2
	20	10

In many cases more than the minimum number of personnel will be required, particularly if offloading or patching/plugging is to be performed. Also, it is assumed that most instrumentation functions have been completed and do not require more than one person of the support group for continuing operation. Cases in which toxic clouds are present will require a larger instrumentation team.

The above estimates hold good for the first eight hours on-scene of the spill. Relief personnel will be required each eight hours. These would be supplied by a second response team.

The number of encapsulated suits required in a major response is seen to be four for the Hot Zone plus 2 for rescue. Normally Relief Crew #1 will also require 4 seperate suits. If the suits can be decontaminated then the four suits from the first shift can be recycled to the third shift, (Relief Crew #2), etc. This gives a requirement of 10 suits for a major response and exactly half as many for a medium or minor response.

4.2.3 Spill Response Van Composition

The preceding description of equipment types and their use in a response mission were used to make up an equipment list for a single response van. This is given in Table 4-4.

Certain assumptions were made to obtain Table 4-4. The list was based on a major spill response, i.e. 20 men. If fewer are required or available, the

TABLE 4-4. ESTIMATED EQUIPMENT REQUIREMENT FOR CHEMICAL SPILL RESPONSE VAN

	INSTRUMENTATION (7.0 CU. FT.)[(1)]	
1.	pH meter (Orion Research Model 2-1)	4
2.	Oxygen meter (Bendix Gas-Tech)	4
3.	Portable Organic Vapor Analyzer (HNU)	2
4.	Combustible gas indicators (MSA Model 20)	4
5.	Multi-Test (indicator tube type,* MSA Universal)	4
6.	Portable weather station	2
7.	Emergency first-aid kits (Coast Guard Approved)	2
8.	Emergency medical equipment (stretcher, blankets (2), oxygen mask and tank)	1
	PROTECTIVE CLOTHING (240 CU. FT.)	
1.	Chemical Goggles	24
2.	Face Shield	12
3.	Coveralls and Jackets (Full Body, Norton)	
	Neoprene	24
	Butyl Rubber	12
	Fluoro-Elastomer	12
4.	Gloves (pairs)	
	Neoprene	24
	Butyl Rubber	12
	Fluoro-Elastomer	24
	EPR	12
	Hypalon	12

*recommended inventory of indicator tubes:

Ammonia	Carbon Monoxide	Hydrogen Sulfide
Hydrocarbons	Chlorine	Vinyl Chloride
Acetone	Formaldehyde	
Alcohol	Monostyrene	
Benzene	Sulfur Dioxide	
Carbon Disulfide	Toluene	

TABLE 4-4. ESTIMATED EQUIPMENT REQUIREMENT FOR CHEMICAL SPILL RESPONSE VAN (Cont.)

5.	Boots (pairs)	
	Neoprene	24
	Butyl Rubber	12
	Fluro-Elastomer	24
	EPR	12
6.	Hood with Faceshield	
	Neoprene	24
	Butyl Rubber	12
	Fluoro-Elastomer	12
7.	Fully Encapsulated Suits	10
8.	Protective/Disposable suits, boots, hoods, and gloves, disposable sets	4
	RESPIRATORY EQUIPMENT (66 CU. FT.)	
1.	Gas Masks - full facepiece canister - (Scott)	16
	Canisters - all purpose	16
	- organic vapors	32
	- ammonia	16
	- carbon monoxide	16
	- acid gases	16
	- chlorine	16
	- particulate	16
2.	Self-Contained Breathing Apparatus with 60-minute supply, positive pressure (Bio Pack 60)	
3.	Oxygen resupply cylinder, 5 ft.	3
	COMMUNICATIONS (12 CU. FT.)	
1.	Two-way radio, 5 km range	18
2.	Gas Mask Microphone (Scott Speak-Ezee)	8
3.	Suit intercom, skull cap, bone mike	24
4.	Two-way van radio (Triton)	1

TABLE 4-4. ESTIMATED EQUIPMENT REQUIREMENT FOR CHEMICAL SPILL RESPONSE VAN (Cont.)

PLUGGING, PATCHING, REPAIR (3.0 CU. FT.)

1.	Plugging kit (bentonite, plugs, gasket material, straps)	2

LIGHT SUPPORT EQUIPMENT (230 CU. FT.)

1.	Escape device, (Robertshaw 5-minute)	12
2.	Tool kit	2
3.	Reference Library	1
4.	Portable shower	1
5.	Eye shower	1
6.	Decontamination support equipment	1 set

(1) Based on packing fraction of 0.25.

van would still serve. (A preliminary response of two to four men, if called for, would be made in a sedan or station wagon or passenger aircraft.) Only items of large size or high cost are listed. The numbers shown for each item include spares in the van but do not include stockpiles or spares at the base.

Only generic types are specified. Specific brands and models are sometimes given in parentheses only as illustrations; equivalent products are often available and may be preferable on the basis of performance, delivery, cost, or other characteristics.

The approximate storage volume within the van to be devoted to each class of equipment is indicated in the Table. A packing fraction of 0.25 was allowed. In addition to the storage volumes, there must be allowed at least 300 cubic feet for entry, working, and egress by two people simultaneously. This brings the total volume to about 1100 cubic feet, well within the volume of available trucks and vans. The useable cargo volume on the C130 is 3252 cubic feet, less an escape aisle, with a height restriction of 8 ft. 6 in. A van of 8 ft. 6 in. overall height, 2 ft. floor height, and 8 ft. width would have to have a cargo area of 21 ft. to give the requisite 1100 cu. ft. volume. Allowing 10 to 15 ft. for the cab portion gives an overall vehicle length of 31 to 36 ft., well within the 41 ft. length of the C130 cargo hold. The escape aisle is provided by the difference between the 96 in. vehicle width and the 120 in. C130 cargo hold width.

A weight analysis has not been performed, but an approximation is obtained by allowing a density of 1.0 for the equipment and its packaging, giving a net weight of about 12,000 lbs for the contents of the van. The payload of the C130B over 1500 n.mi. is about 20,000 lbs and that of the C130H over 2500 n.mi. is about 30,000 lbs. This would give maximum unloaded weights for the vehicle itself of 8,000 lbs and 18,000 lbs, respectively. The smaller of those figures may present some difficulty, but better estimates must be made, after specific items of equipment have been selected, in order to determine whether the C130B can transport the van as described.

4.2.4 Offloading and Support Equipment

In addition to the basic response van, loaded with the equipment of Table 4-4, one or more auxiliary support vehicles may be dispatched. The primary such vehicle should carry offloading equipment, such as described in Table 4-5. If an offloading operation is called for, a selection of this equipment can be mounted on the 32 ft. low bed semitrailers (Model GPX-12-FS) currently located at the USCG Strike Team bases. These semitrailers are C130-air transportable.

Most chemical response missions do not call for an offloading operation by the Coast Guard team, because commercial, private or spiller resources are better able to perform the operation. The decision to commence unloading is usually reached several hours, or even days, after the first response personnel have arrived, because a substantial amount of information must be gathered before the decision can be made. Therefore, outside assistance will usually have arrived by the time it is decided to offload. For this reason USCG offloading equipment need not be dispatched immediately and routinely along with the basic spill response van previously described.

TABLE 4-5. OFFLOADING AND HEAVY SUPPORT EQUIPMENT FOR CHEMICAL SPILL RESPONSE

OFFLOADING EQUIPMENT

1.	Explosion-proof hydraulic chemical transfer pumps, teflon lined, with power source	2
2.	Stainless steel hose - 500 feet	
3.	Nitrile-lined bladder tank - Dracone Type D - (10,000 USG)	2
4.	Overpack drums	50
5.	ADAPTS Stainless steel pump	2
6.	Prime mover for ADAPTS	1

HEAVY SUPPORT EQUIPMENT

1.	10 KW diesel-driven generator, portable	2
2.	Command Center Van, USCG Pollution Response	1
3.	Four-wheel drive vehicle	1
4.	Decontamination Trailer with generator	1
5.	Semi-trailer, air transportable	1

5. RESPONSE UNIT DEPLOYMENT

The major questions to be dealt with in this section are those of the locations and the numbers of USCG response units for hazardous chemical spills. The units under discussion are the response vans and offloading trailers described in the preceding section. The spill threat to be met is that described in Section 3.

5.1 METHODOLOGY

(a) A set of response base configurations will be selected for evaluation. Each configuration will consist of several bases at which one or more vans, trailers or both are stationed.

(b) Response time will be calculated for each configuration. The response time is the time from receipt at the base of a request for assistance to the time the first vehicle arrives at the spill site or other location designated by the OSC.

(c) Numbers of response vans and trailers required at each base will be calculated on the assumption that there are enough at each base to respond to 90 percent of the spills without delay.

(d) The various configurations will be compared in terms of number of sites, level of personnel, response times, and number of response units and an overall evaluation made.

5.2 BASE CONFIGURATIONS

A base configuration is a set of locations (assumed to be existing USCG installations) at which chemical spill response equipment and personnel are to be located. In addition to one or more response vans and/or trailers, the base must accommodate at least 20 men (who may also perform oil pollution response functions), as well as supporting staff, storage and repair facilities, etc. If the base is at or near one of the five USCG air stations at which C130B or C130H aircraft are based, then the equipment will be available for assistance well beyond the area normally served by the base.

A hazardous chemical spill is assumed to be responded to by the nearest base. Assistance can also be obtained from adjacent bases and from air transported units.

The simplest (non-trivial) base configuration is a single base for the entire U.S. If it is to serve both coasts, it clearly must be an air base. These are, at present, the C130B bases at Barbers Point HI, Clearwater FL, and Elizabeth City, NC, and the C130H bases at Sacramento, CA, and Kodiak, AK. The minimum coast-to-coast time is about 11 hours for the C130H (dashed line in Figure 7-10, Reference 1) and more for the C130B because of the need for refueling enroute. Since 79 percent of the hazchem spills in 1973-79 occurred in the east (i.e., East Coast, Gulf Coast, Central States) the Elizabeth City or Clearwater bases would yield lower average response times than the others. Since Elizabeth City is presently a Strike Team base it is preferred. Therefore a single base at Elizabeth City is the simplest configuration to be considered.

The next largest configuration to be considered is that of the three Strike Team bases: Hamilton AFB, CA, Bay St. Louis, MS, and Elizabeth City, NC. These cover each of the three coasts. Air transport is easily available at Hamilton AFB and Elizabeth City; it is slightly less accessible at Bay St. Louis, which must employ the New Orleans airports.

The third configuration to be considered is that of the eleven planned USCG pollution response bases. These bases have been selected to yield a 12-hour response time for 95 percent of the oil spills expected in 1980-90. Insofar as the potential for chemical spills agrees with that for oil spills, the same configuration would be efficient for chemical response bases. In actuality, the 2nd and 9th Districts show 27 percent of the PIRS chemical spill records and 53 percent of the MTB chemical spill records. The 11-base oil-spill configuration does not include a base in the central portion of the U.S., in which Districts 2 and 9 lie.

A final trial configuration was obtained on the basis of OSC areas of responsibility, as follows:

The number of spills recorded in PIRS for 1973-79 were tabulated for each MSO/COTP area, since each corresponds to an OSC assignment. Only spills were counted for which the quantity released exceeded certain levels, set for each

chemical. (See Appendix C1.) These levels were selected to represent the average spill size normally warranting a U.S. Coast Guard response. These 'respondable' spills are tabulated by MSO/COTP area in Table 5-1. The corresponding MTB spills in 1976-79 are also shown. The breakdown by coastal region of these 'respondable' spills is compared with the same breakdown for all spills in Table 5-2. It is seen in Table 5-2 that while all PIRS spills are relatively evenly distributed, 'respondable' spills are more heavily concentrated in Districts 2 and 9, and less heavily concentrated in Districts 11, 12, 13. This concentration in the central U.S. is also seen in the distribution of MTB spills, Table 5-2. The restriction to 'respondable' spills improves the agreement between MTB and PIRS data; the rank correlation coefficient increases from .4 to .8 when that restriction is made on the data set. This suggests that the distribution of response capability by coastal area should be about 25 percent, 20 percent, 15 percent, 40 percent for Eastern, Gulf, Western, and Central areas, similar to Table 5-2.

An eleven-site configuration was obtained from the above percentages by assigning three sites to the East Coast, two sites to the Gulf Coast, two sites to the West Coast, and four sites to the Central U.S. Specific locations were obtained by identifying the sub-areas on each coast with high incidence of PIRS-recorded spills. Figures 5-1(a) through (d) show the counties of interest with encirclements of county groups having substantial numbers of spills in 1973-79.

East Coast (Figure 5.1(a)) - The major areas of spill activity have been (1) the greater New York-New Jersey region, (2) the Wilmington-Philadelphia-Trenton region, and (3) the western shore of the Chesapeake Bay (Norfolk to Baltimore). This suggests sites at New York, Philadelphia, and Washington, DC. The latter, however, can be replaced by the Elizabeth City Strike Team, which has the advantage of an air base.

Gulf Coast (Figure 5-1(b)) - The two Gulf Coast sites are New Orleans and Galveston-Houston.

West Coast (Figure 5-1(c)) - The two West Coast sites are best located at Los Angeles and San Francisco.

Central U.S. (Figure 5-1(d)) - The widespread spill pattern in the central U.S. makes adequate coverage difficult. The most direct approach places bases at

TABLE 5-1. RESPONDABLE SPILLS BY MSO/COTP PIRS (1973-79) AND MTB (1976-79) DATA

CGD	MSO/COTP AREA		PIRS '73-'79	MTB '76-'79
1	MSO	PORTLAND, ME	7	3
1	MSO	BOSTON, MA	6	6
1	MSO	PROVIDENCE, RI	3	5
3	COTP	NEW LONDON, CT	1	0
3	COTP	NEW HAVEN, CT	10	0
3	COTP	NEW YORK, NY	44	29
3	MSO	ALBANY, NY	30	8
3	COTP	GLOUCESTER CITY, NJ	24	21
5	MSO	BALTIMORE, MD	20	9
5	MSO	HAMPTON ROADS, VA	26	7
5	MSO	WILMINGTON, NC	4	6
7	MSO	CHARLESTON, SC	9	3
7	MSO	SAVANNAH, GA	14	2
7	MSO	JACKSONVILLE, FL	7	1
7	MSO	MIAMI, FL	3	7
7	MSO	TAMPA, FL	2	5
8	MSO	MOBILE, AL	9	24
8	COTP	NEW ORLEANS, LA	34	20
8	MSO	PORT ARTHUR, TX	6	5
8	MSO	GALVESTON, TX	18	3
8	COTP	HOUSTON, TX	18	5
8	MSO	CORPUS CHRISTI, TX	11	5
11	MSO	SAN DIEGO, CA	2	1
11	MSO	LONG BEACH, CA	26	25
11	COTP	MONTEREY, CA	0	5
12	MSO	SAN FRANCISCO, CA	40	16
12	COTP	HUMBOLT BAY, CA	5	2
13	MSO	PORTLAND, OR	9	27
13	COTP	SEATTLE, WA	13	13
2	MSO	MEMPHIS, TN	16	9
2	MSO	PADUCAH, KY	5	1
2	MSO	SAINT LOUIS, MO	25	12
2	MSO	SAINT PAUL, MN	11	19
2	MSO	LOUISVILLE, KY	23	12
2	MSO	NASHVILLE, TN	23	20
2	MSO	CINCINNATI, OH	23	15
2	MSO	HUNTINGTON, WV	25	10
2	MSO	PITTSBURGH, PA	25	22
9	MSO	DULUTH, MN	0	2
9	COTP	SAULT STE MARIE, MI	0	0
9	MSO	MILWAUKEE, WI	6	1
9	COTP	MUSKEGON, MI	10	4
9	MSO	CHICAGO, IL	17	45
9	MSO	DETROIT, MI	16	18
9	MSO	TOLEDO, OH	14	12
9	MSO	CLEVELAND, OH	6	5
9	MSO	BUFFALO, NY	14	16

TABLE 5-1. RESPONDABLE SPILLS BY MSO/COTP PIRS (1973-79) AND MTB (1976-79) DATA (CONT.)

CGD	MSO/COTP AREA		PIRS '73-'79	MTB '76-'79
14	MSO	HONOLULU, HI	-	1
17	MSO	ANCHORAGE, AK	-	4
17	MSO	JUNEAU, AK	-	0
17	MSO	VALDEZ, AK	-	0
7	MSO	OLD SAN JUAN, PR	7	-
			667	491

correlation coefficient = .574.

TABLE 5-2. ANALYSIS BY COASTAL REGION OF RESPONDABLE AND TOTAL SPILLS FOR PIRS AND MTB DATA

PIRS

USCG DISTRICTS	TOTAL		RESPONDABLE	
	RECORDS	PERCENT	SPILLS	PERCENT
1, 3, 5	1,633	24	175	26
7, 8	1,899	28	138	21
11, 12, 13	1,415	21	95	14
2, 9	1,883	27	259	39
	6,830	100	667	100

MTB

USCG DISTRICTS	RECORDS	PERCENT	SPILLS	PERCENT
1, 3, 5	7,526	23	94	19
7, 8	3,819	12	80	16
11, 12, 13	3,360	10	89	18
2, 9	16,751	52	223	46
14, 17	884	3	5	1
	32,340	100	491	100

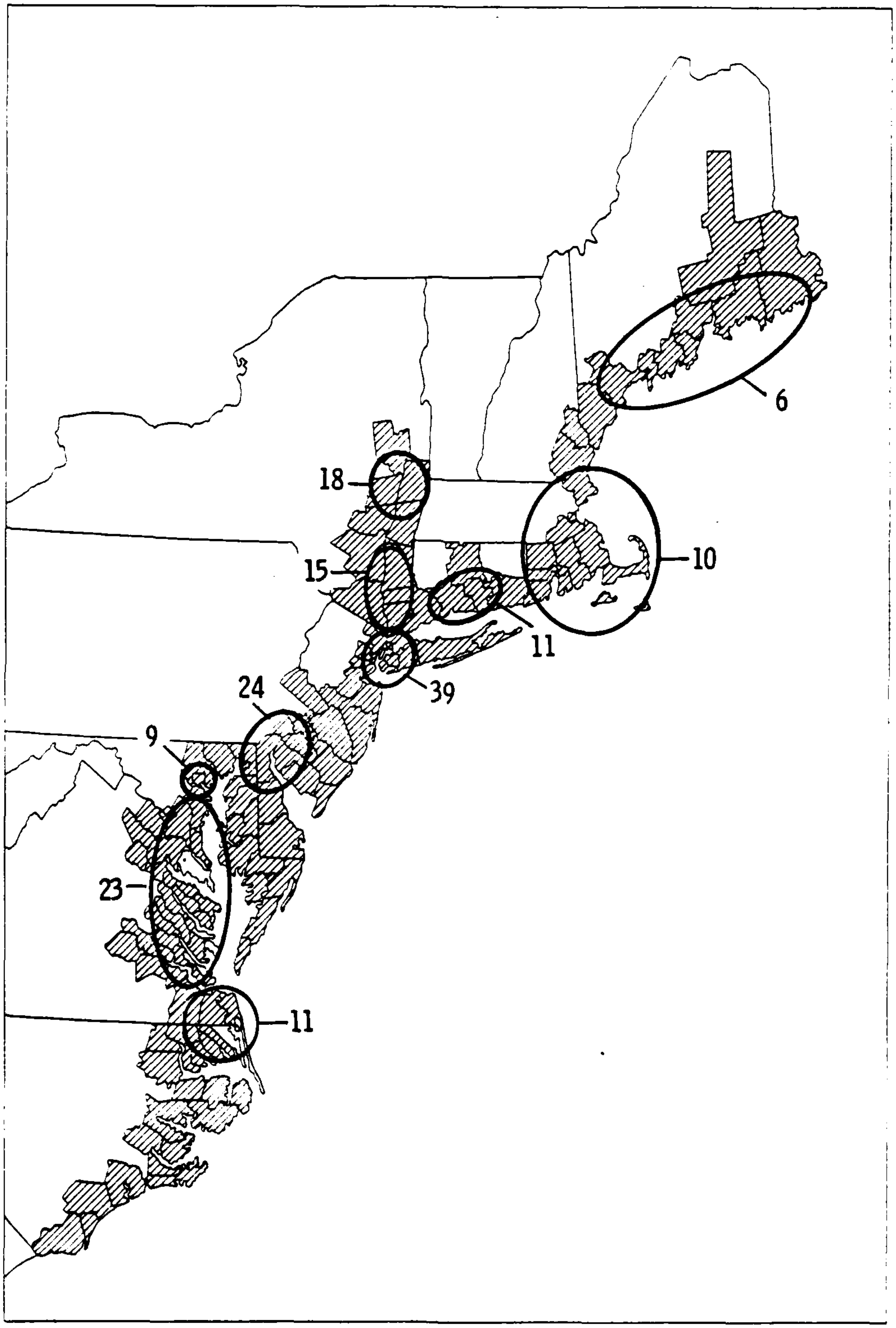


FIGURE 5-1(a). MAJOR AREAS OF CHEMICAL SPILLS, PIRS 1973-79, EAST COAST

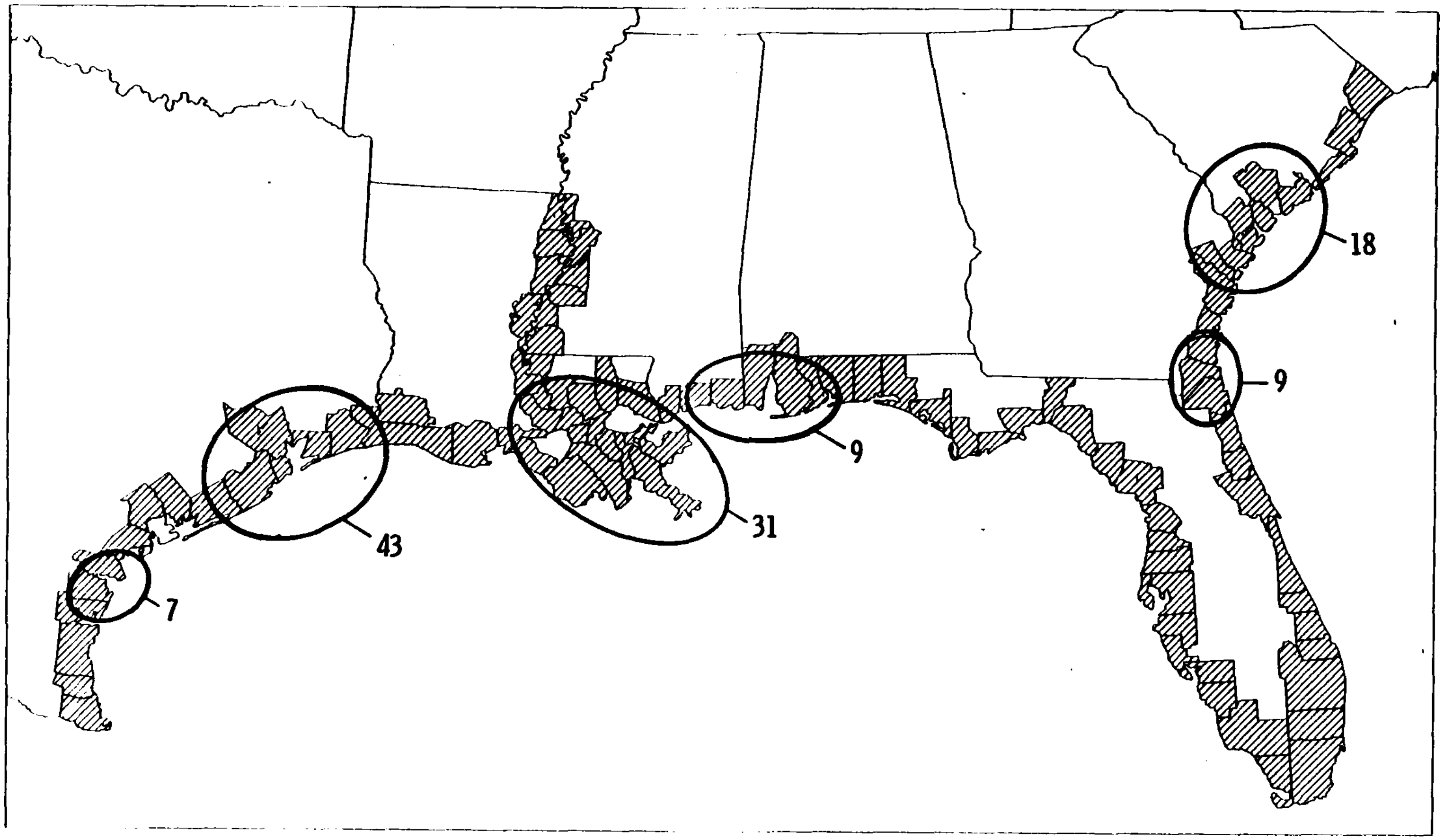


FIGURE 5-1(b). MAJOR AREAS OF SPILLS, PIRS 1973-79, GULF COAST

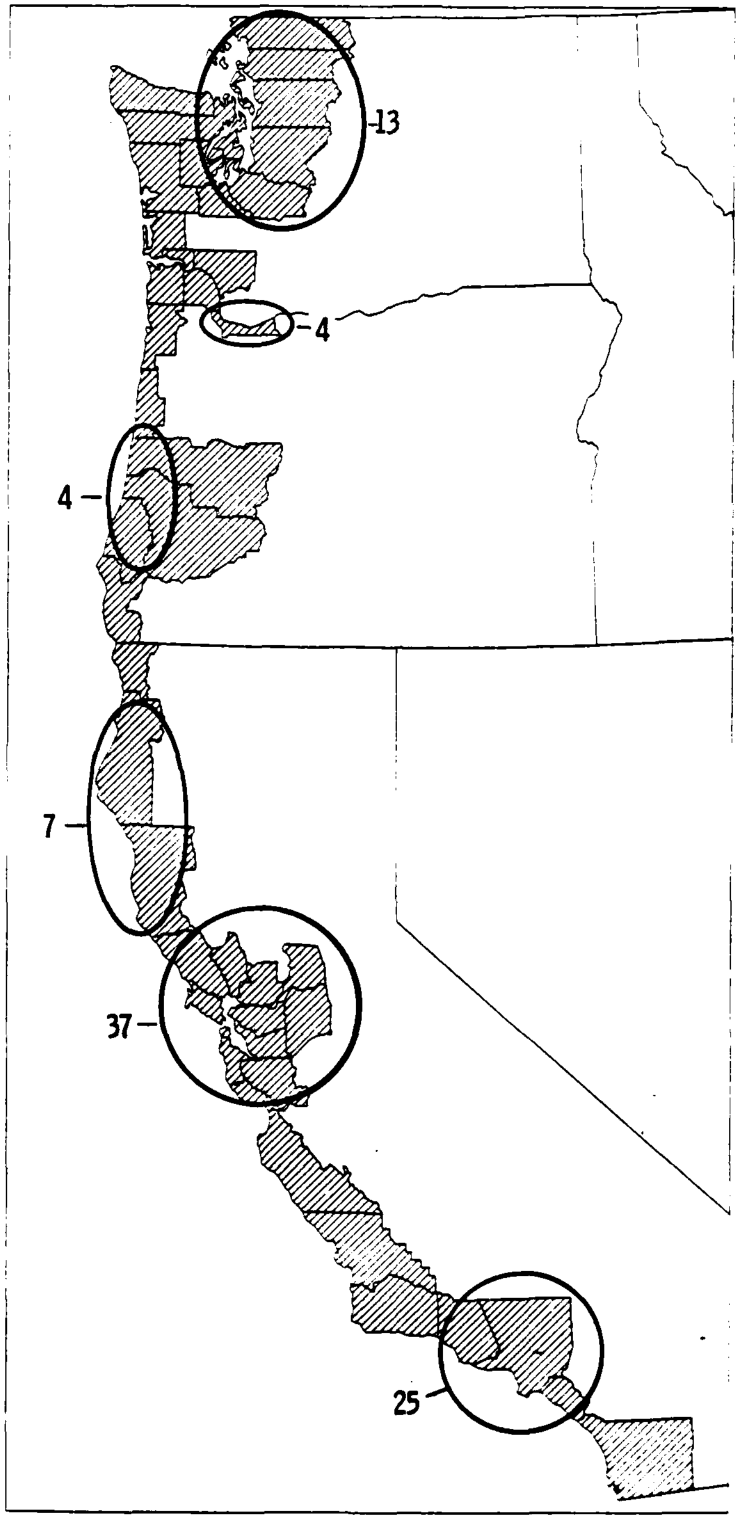


FIGURE 5-1(c). MAJOR AREAS OF CHEMICAL SPILL, PIRS 1973-79, WEST COAST

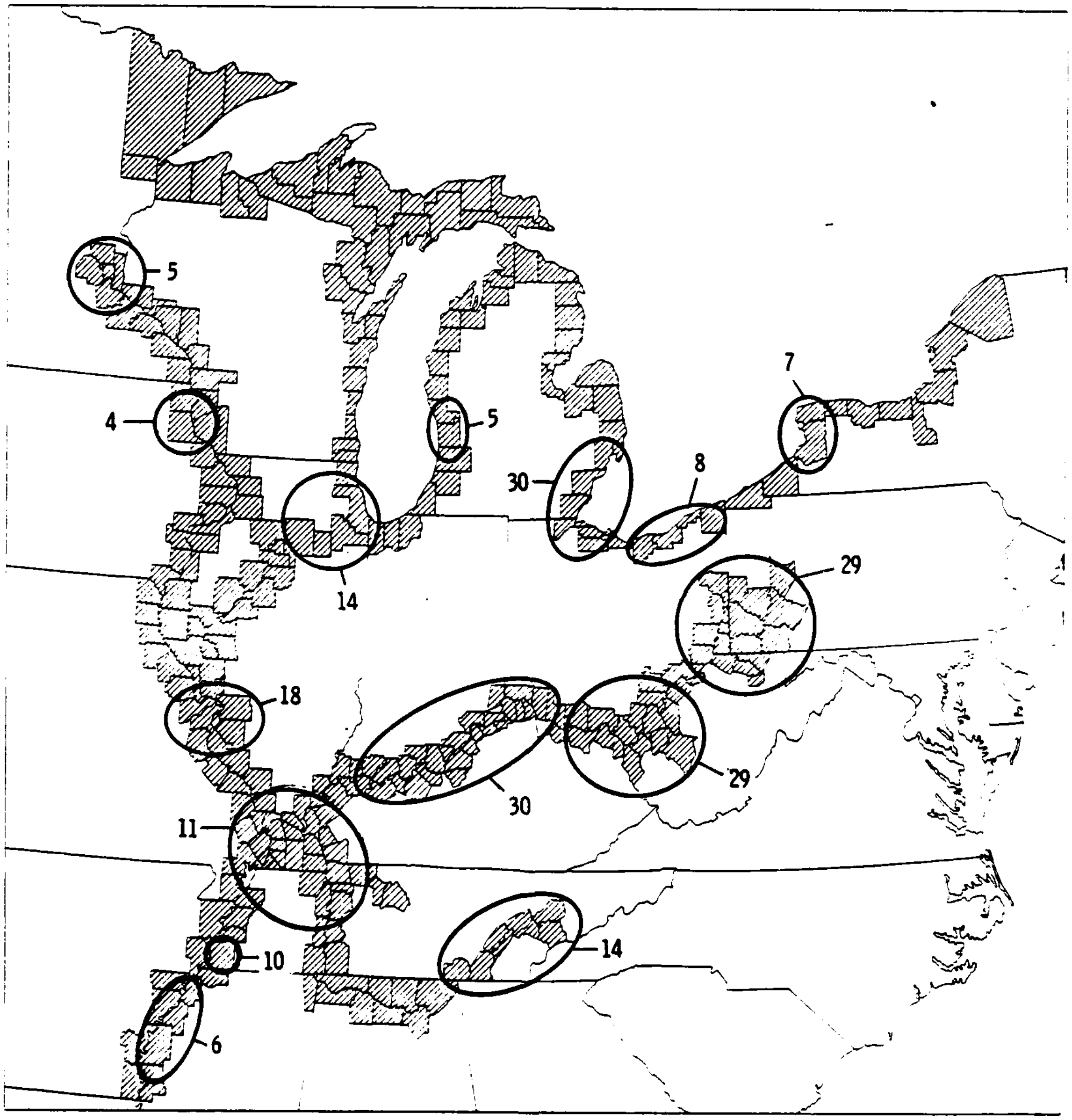


FIGURE 5-1(d). MAJOR AREAS OF CHEMICAL SPILLS, PIRS 1973-79, CENTRAL U.S.

Detroit/Toledo, Pittsburgh, Cincinnati, and St. Louis. This leaves heavy spill areas such as Knoxville, Memphis, Chicago, and, primarily, Charleston, WV without direct coverage. Charleston WV, however, is less than 5 road hours from Cincinnati and Pittsburgh; also Chicago is less than 5 road hours from Toledo. But response times would be improved by placing one site at Cairo, IL (MSO Paducah, KY) rather than St. Louis, from which both St. Louis and Memphis are accessible in less than 4 road hours. Therefore, the four sites are selected at the MSO's: Toledo, Pittsburgh, Cincinnati, Paducah.

Table 5-3 shows the four candidate site configurations. The table also shows the Districts or OSC areas covered by each base.

5.3 RESPONSE TIMES

Response time is defined as the time from request by the OSC for assistance to arrival at the spill scene of the first van or offloading trailer, from the assigned response base. The response time for each configuration depends on the spill location relative to the base, and on the mode of transport, i.e., land or air. The mean response time for each base was determined by estimating the response time from the base to the respondable spills shown in Figure 5-1. The response times were weighted in proportion to the number of spills. The mode of transport was taken to be over-the-road, except for spills covered from one of the air bases [Elizabeth City, Hamilton AFB]. In those cases the air mode was assumed if it resulted in a lower response time to the spill.

The ground response time was calculated as $(A + R/33.33)$ hours, where R is the great-circle distance from base to spill in nautical miles, and A is the sum of the following intervals:

1.	Receipt of request, notification of CO	.25 hours
2.	Assembly of team	.50
3.	Vehicle inspection and preparation	.25
4.	Team briefing	.25
	A =	1.25 hours

This value of A assumes a pre-loaded response van.

The air response time was calculated as $B + R/300$ hours, where B is the sum of the following intervals:

TABLE 5-3. CANDIDATE SITE CONFIGURATIONS

SITE LOCATION [DISTRICTS IN MSO/COTP AREAS COVERED]

SINGLE SITE

*Elizabeth City, NC [all]

STRIKE TEAM CONFIGURATION

*Elizabeth City, NC [1st, 3rd, 5th, 2nd, 9th districts]
Bay St. Louis, MS [7th, 8th districts]
*Hamilton AFB, CA [11th, 12th, 13th, 14th, 17th districts]

ELEVEN SITE CONFIGURATION

Boston, MA [Boston, Portland, Providence]
New York, NY [New London, New Haven, Albany, New York]
Gloucester City, NJ [Baltimore]
*Elizabeth City, NC [Hampton Rds, Wilmington, 2nd, 9th districts]
Miami, FL [Charleston, Savannah, Jacksonville, Miami, Tampa, San Juan]
Bay St. Louis, MS [Mobile, New Orleans]
Galveston, TX [Port Arthur, Galveston, Houston, Corpus Christi]
Long Beach, CA [San Diego, Los Angeles]
*Hamilton AFB, CA [Monterey, San Francisco, Humbolt Bay, 14th district]
Seattle, WA [Portland, Seattle]
Kodiak, AK [17th district]

MODIFIED ELEVEN SITE CONFIGURATION

New York, NY [1st, 3rd districts, except COTP Groton, NJ]
Gloucester City, NJ [Baltimore]
*Elizabeth City, NC [Hampton Rds, Wilmington, Charleston, Savannah, Jacksonville, Miami]
Bay St. Louis, MS [Tampa, Mobile, New Orleans]
Galveston, TX [Port Arthur, Galveston, Houston, Corpus Christi]
Long Beach, CA [San Diego, Los Angeles]
*Hamilton AFB, CA [12th, 13th, 14th, 17th districts]
Toledo, OH [9th district]
Pittsburgh, PA [Pittsburgh, Huntington]
Cincinnati, OH [Cincinnati, Louisville]
Paducah, KY [Nashville, Memphis, Paducah, St. Louis, St. Paul]

*Air base

from Elizabeth City, NC

1.	Receipt of request		.25 hours
2.	Aircraft requisition		.25
3.	Aircraft preparation (1.00 hr)		
4.	Team assembly (.50 hr)		
5.	Vehicle inspection (.25 hr)		
6.	Maximum of 3., 4., 5.		1.00
7.	Aircraft loading		.50
8.	Aircraft checkout, takeoff, landing, refuel,		.50
	takeoff (over 1500 n.mi.)		2.00
9.	Aircraft landing, taxi		.25
10.	Aircraft unloading		.50
11.	Travel to spill location		.50
		B =	3.75
		=	5.75 (over 1500 n.mi.)

from Hamilton AFB, CA

1.	Receipt of request		.25
2.	Aircraft requisition		.25
3.	Aircraft preparation, takeoff ferry to Hamilton AFB (1.75)		
4.	Team assembly (.50)		
5.	Van inspection (.25)		
6.	Maximum of 3., 4., 5.		1.75
7.	Aircraft loading		.50
8.	Aircraft checkout, takeoff		.50
9.	Aircraft landing, taxi		.25
10.	Aircraft unloading		.50
11.	Travel to spill location		.50
		B =	4.50

These response times are plotted in Figure 5-2. They apply to the off-loading trailers as well as to the chemical response vans, both being air transportable. It will be noticed that air transport is faster than land transport for distances greater than about 90 n.mi. from Elizabeth City, NC and for distances greater than about 125 n.mi from Hamilton AFB. In fact many remote lo-

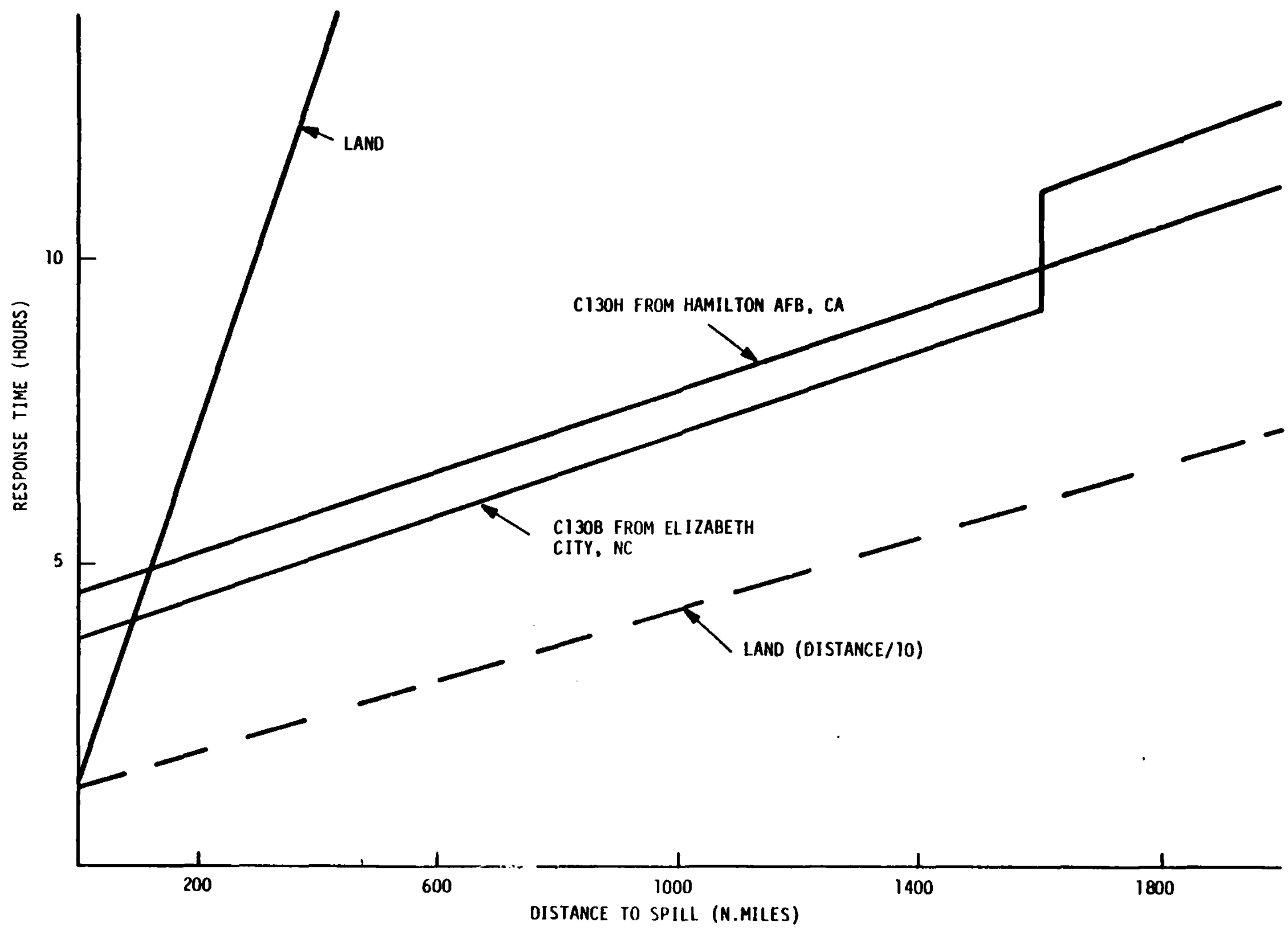


FIGURE 5-? RESPONSE TIMES FOR LAND AND AIR

cations are served more rapidly by air from Elizabeth City or Hamilton AFB, than by land from the nearest base.

The results of the response time calculations are shown in Table 5-4. As expected, the Strike Team Configuration has lower response times than the single-site, but the reduction in mean response time is only 5 percent, even though the number of bases is tripled. Moreover, the maximum response time <u>increases</u> to 18.8 hours from 13.3 hours. This is due to the land responses originating from Bay St. Louis, the longest of which are to Miami, FL and Brownsville, TX. Clearly, the single-site is competitive with the Strike Team Configuration because of the lower response times achievable by air from Elizabeth City, NC.

The 11-Site Configuration achieves the lowest mean response time of the four configurations. The striking aspect of this configuration is the large mean and maximum response times from Miami, FL. This is due in large part to responses from Miami to Savannah, GA and Jacksonville, FL areas. These spills are more expeditiously handled by air from Elizabeth City, NC in the single-site configuration.

The Modified 11-Site Configuration has a mean response time greater than the original 11-Site Configuration. The attempt to reduce response times by four sites placed in the Central U.S. (Districts 2 and 9) has actually resulted in longer response times. The reason is that land response from those four bases is longer than the air response from Elizabeth City, NC that they replaced. Another difficulty with the Modified 11-Site Configuration is the long response time from Bay St. Louis, which serves by land the large area formerly covered from Miami, FL.

One conclusion that emerges from the above comparisons is that areas in the Eastern U.S., more than 100-200 n.mi from a land base are usually reached more rapidly by air from Elizabeth City than from the land base. For example, the 79 spills serviced from Paducah, KY in the modified 11-Site Configuration are scattered along the lower and upper Mississippi from Memphis to St. Paul. The average response time by land from Paducah is 7.44 hours; but they can be reached from Elizabeth City by air in 5.07 hours or less, as seen in the Strike Team Configuration. The same is true of the lower eastern coast, from South Carolina to Florida, which require, on average, from 10 to 12 hours by land from Miami or Bay St. Louis, but which are reached by air from Elizabeth City in 5-6 hours.

TABLE 5-4. MEAN AND MAXIMUM RESPONSE TIMES[1] FOR FOUR SITE CONFIGURATIONS

NAME OF SITE (CITY)	RESPONDABLE SPILLS '73-'79 (PIRS Recs)	MEAN RESPONSE (hours)	MAXIMUM RESPONSE (hours)
SINGLE-SITE CONFIGURATION			
*Elizabeth City, NC	631	6.58	13.3
STRIKE TEAM CONFIGURATION			
*Elizabeth City, NC	410	5.07	6.3
Bay St. Louis, MS	127	11.50	18.8
*Hamilton AFB, CA	94	4.27	6.5
	631	6.24	18.8
11-SITE CONFIGURATION			
Boston, MA	16	4.03	6.7
New York, NY	83	3.35	4.8
Gloucester City, NJ	33	2.70	3.6
*Elizabeth City, NC	278	5.17	6.3
Miami, FL	35	10.25	13.3
Bay St. Louis, MS	40	3.64	5.2
Galveston, TX	52	3.58	9.1
Long Beach, CA	28	2.35	4.4
* Hamilton AFB, CA	44	2.62	5.1
Seattle, WA	22	4.32	9.4
Kodiak, AK	--	---	--
	631	4.49	13.3
MODIFIED 11-SITE CONFIGURATION			
New York, NY	99	4.08	11.0
Glocester City, NJ	33	2.74	3.6
*Elizabeth City, NC	36	3.89	4.3
Bay St. Louis, MS	75	12.14	18.8
Galveston, TX	52	3.58	9.1
Long Beach, CA	28	2.35	4.4
*Hamilton AFB, CA	66	3.74	6.5
Paducah, KY	79	7.44	16.9
Toledo, OH	75	5.35	12.2
Pittsburgh, PA	29	2.81	2.8
Cincinnati, OH	59	4.37	4.4
	631	5.34	18.8

(1) Responses to Alaska, Hawaii, Puerto Rico, and Virgin Islands not included.

*Assumed to respond by air when a lower response time would result.

A corollary of the above conclusion is that land-based response sites are most effective in areas of high spill density. This is seen, for example in Galveston, Long Beach, San Francisco, and Groton, NJ; these are areas of high spill density, with limited geographic extent because of adjacent land bases, as in the Modified 11-Site Configuration.

The above results suggest a means to improve the response times of the 11-Site Configuration, which has the lowest mean response time of the four candidates. This is done by eliminating the site at Miami, and servicing the area it covers by air from Elizabeth City, NC. The result is to reduce the mean response time for spills in Miami's area from 11.25 hours to 5.27 hours, and to reduce the mean response time for the entire configuration from 4.49 hours to 4.29 hours. A further improvement can be achieved by elimination of the Boston, Seattle and Kodiak sites, since their areas can be served by air without seriously affecting the mean response time. The statistics for the resulting 7-Site Configuration are given in Table 5-5. It is assumed in that Table that Elizabeth City provides response time for the 1st, 2nd, 9th, and 7th Districts, and for the 5th District below Baltimore. This table shows that a Seven-Site Configuration with air support is more effective than the 11-Site Configuration of Table 5-4.

A final improvement suggests itself in the Modified 11-Site Configuration. The Cincinnati and Paducah sites may be placed at Louisville and Huntington, and along with Pittsburgh and Toledo they are restricted to responses within about 100 n.miles of the site, the remaining area being covered by air from Elizabeth City, NC. The resultant response time statistics are shown in Table 5-6. This configuration is the same as the 7-Site Configuration except for the direct land coverage provided by the four Central sites within their immediate area. The Table (5-6) shows that this 11-Site Configuration with air support is not only superior in response time to the 7-Site Configuration with air support, but also the 11-Site Configuration of Table 5-4.

5.4 NUMBER OF RESPONSE UNITS

The response times calculated in the subsection above referred to the arrival of the first unit, usually a chemical response van. This van, as described in Section 4, is assumed to provide adequate support for a 20-man team. It is assumed that at the end of the response action at the site, the unit will

TABLE 5-5. SEVEN-SITE CONFIGURATION - RESPONSE TIMES(1)

NAME OF SITE (CITY)	RESPONDABLE SPILLS, '73-'79 (PIRS recs)	MEAN RESPONSE (hours)	MAXIMUM RESPONSE (hours)
SEVEN-SITE CONFIGURATION			
New York, NY	83	3.35	4.8
Gloucester City, NJ	33	2.70	3.6
*Elizabeth City, NC	329	5.20	6.9
Bay St. Louis, MS	40	3.64	5.2
Galveston, TX	52	3.58	9.1
Long Beach, CA	28	2.35	4.4
*Hamilton AFB, CA	66	3.74	6.5
	631	4.32	9.1

(1) Response times to Alaska, Hawaii, Puerto Rico not included.

*Response by air when a lower response time would result.

TABLE 5-6. MODIFIED 11-SITE CONFIGURATION WITH AIR - RESPONSE TIMES[1]

NAME OF SITE (CITY)	RESPONDABLE SPILLS, '73-'79 (PIRS recs)	MEAN RESPONSE (hours)	MAXIMUM RESPONSE (hours)
MODIFIED 11-SITE CONFIGURATION WITH AIR			
New York, NY	83	3.35	4.8
Gloucester City, NJ	33	2.70	3.6
*Elizabeth City, NC	211	5.26	6.9
Bay St. Louis, MS	40	3.64	5.2
Galveston, TX	52	3.58	9.1
Long Beach, CA	28	2.35	4.4
*Hamilton AFB, CA	66	3.74	6.5
Pittsburgh, PA	29	3.20	4.0
Louisville, KY	30	2.80	3.2
Huntington, WV	29	2.80	3.0
Toledo, OH	30	3.20	4.0
	631	3.93	9.1

(1) Response to Alaska, Hawaii, Puerto Rico and Virgin Islands not included.

*Response by air when a lower response time would result.

be returned to its base for refurbishment. In some cases, however, a second spill may occur within the area covered by the unit before it can be returned and readied for the next mission. This second spill may be responded to by a unit from an adjacent site, or from one of the air sites. But if such overlapping demands are common, there will result an increase in the mean response time and in the possibility of non-availability of a unit. In order to guard against such possibilities, and to provide adequate spares, it is desirable to station more than one unit at some of the sites. This section calculates how many units are required at each site of the various configurations in order to assure a unit available from the assigned site in 90 percent of the spill incidents. The number of units required depends critically upon two parameters: (1) the number of respondable spills per year occurring in the jurisdiction of the site, and (2) the time required to respond to a spill, return, and refurbish the unit for the next mission. As will be seen, these two parameters may be combined conveniently into a single variable: the number of spills per mission cycle time t.

5.4.1 Analysis

It is assumed that each spill occurring within the response area of a base is to be responded to by one of the n units assigned to the base, if any are available. A unit responding to a spill is assumed to be unavailable for t days after initiation of its response action. This time will be referred to as the response cycle time. It is desired to assign enough units to the base so that the probability is less than χ% of no unit being available when a spill occurs. The requests for response units are assumed to arrive at the base randomly, i.e., as a Poisson process in time. The process is assumed to have a known mean rate λ, for the base in question.

As formulated above the problem is that of a queueing system with Poisson input and n servers in parallel. The requests for spill response are the inputs and the response units are the servers. It will be assumed that the service time, i.e., the response cycle time, is exponentially distributed, with mean response time $t=1/\mu$. The steady-state probability that the number of spills, including those being serviced, will exceed the number of response units is (Reference 14) P(r,n):

$$P(r,n) = K/(S + K)$$

where:

$$K = \frac{r^n}{n!}\;\frac{r/n}{1-r/n}$$

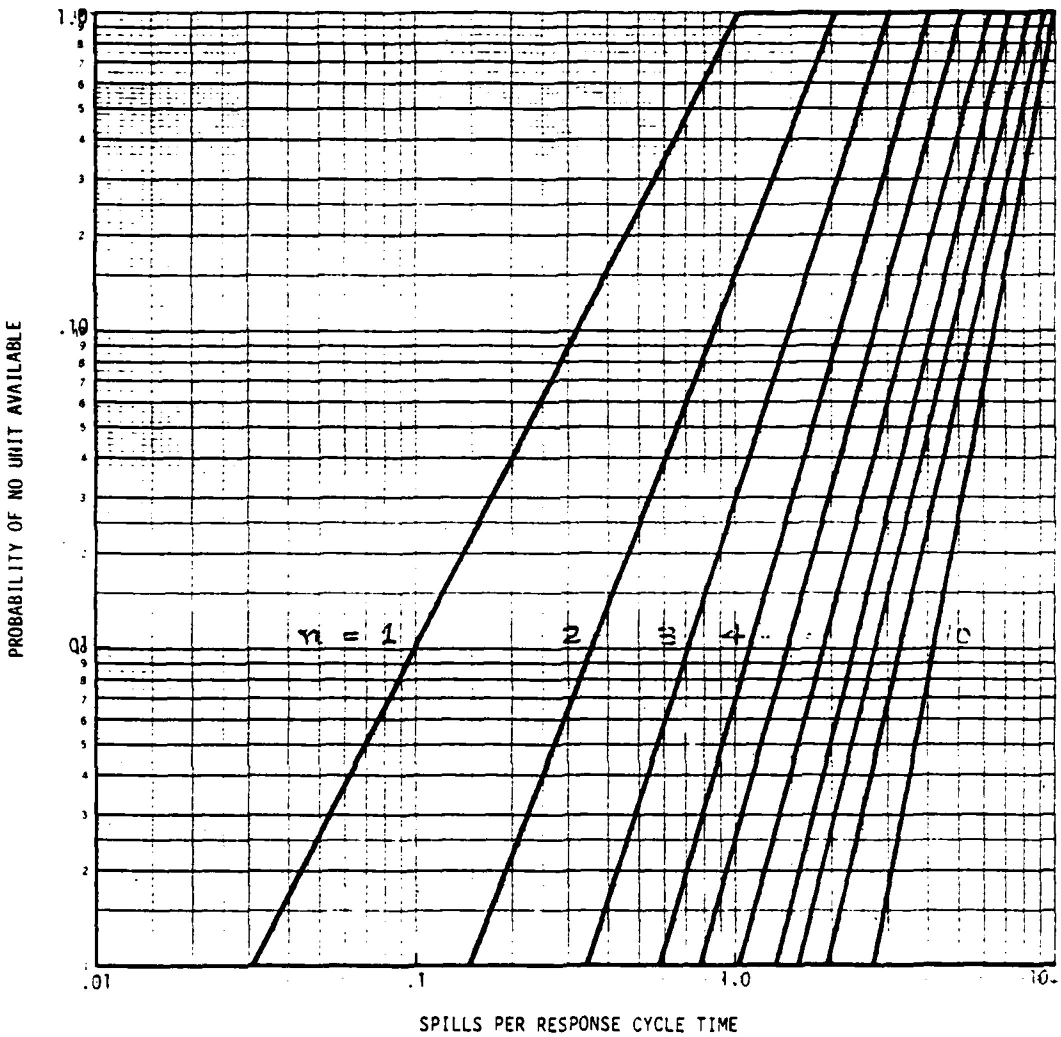
$$S = \sum_{i=o}^{n} r^i/i!$$

$$r = \lambda/\mu = \lambda t$$

The probability $P(r,n)$ is plotted in Figure 5-3 as a function of r. It shows the steady state probabilities of the spill demands exceeding the number of response units assigned to a site, as a function of the ratio of demand rate to service rate of a single unit. The probability goes to unity when that ratio equals the number of units available at the site. Stated another way: when the spill rate exceeds the combined service rate of all the units, the probability is unity that in the steady state there will be spills waiting for a free unit. The analysis can be refined by considering other than exponential distributions of the response cycle time, and by looking at the probabilities in the transient state, e.g., starting from no units out on call. These refinements are considered unnecessary at the present level of analysis and with the present accuracy of data.

5.4.2 Application of the Analysis

In order to employ Figure 5-3 a value must be assigned to r, the ratio of spill rate to (single unit) response rate. The rate at which spills can be expected to occur in the area covered by a site can be deduced from the PIRS spill data. Only 'respondable' incidents will be taken account of (See Section 5.2 and Table 5-1). The respondable spills per year for the entire U.S. are plotted in Figure 5-4, both as a percent of all spills listed in PIRS for 1973-79 and as a percent of only those spills in PIRS for 1973-79 that have an entry in the data field for quantity released. It is seen that, in both cases, the percent of spills above 'respondable' levels shows a smoothly diminishing increase from 1974 to 1978. This is not unlike the behavior of the total PIRS spill rate, Figure 3-4. It is difficult to conceive of a mechanism whereby the occurrence of larger spills would increase relative to spills of all sizes in a fashion so similar to the increase in overall spill history. The explanation may lie in a real increase in 'respondable' spills, or in a reporting anomaly. In either case the latter four years are more representative of the rate of 'respondable' spill occurrences in the next few years, than are the first three years shown in



n = number of response units assigned to base

FIGURE 5-3. PROBABILITY OF NO RESPONSE UNIT BEING AVAILABLE AS A FUNCTION OF THE NUMBER OF SPILLS PER RESPONSE CYCLE TIME

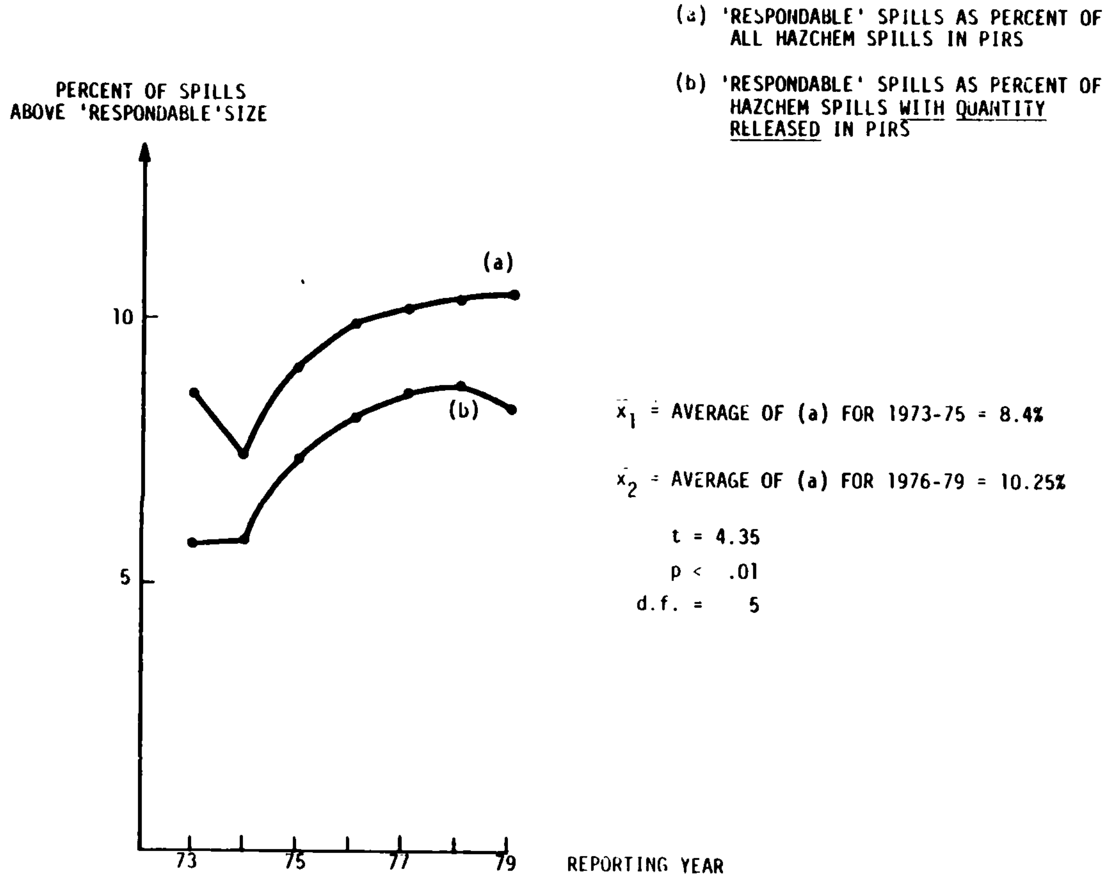


FIGURE 5-4. RESPONDABLE SPILLS IN PIRS, 1973-79

Figure 5-4. The difference in the means (10.25 percent - 8.4 percent) is significant at the 99 percent level. For this reason the last four years are more suitable for determining the spill rate within each of the areas covered by the sites of the various candidate configurations. Restriction to these years, however, would dilute the geographic significance of the data. In order to avoid this dilution, the entire seven years ('73-'79) of data were employed, with an amplification factor of 1.20, obtained as the ratio of the '76-'79 spill rate (114.50 spills per year) to the '73-'79 spill rate (95.29 spills per year). Only respondable spills are included in both cases. A detailed breakdown of respondable spills, both PIRS and MTB, is given in Table 5-7.

The formulas for P(r,n) and the chart in Figure 5-3, were applied to the 6 configurations, with the results shown in Table 5-8. The 1.20 amplification factor was applied to the '73-'79 spills for each site of the six candidate configurations shown in Tables 5-4, 5-5, and 5-6. The result was used to calculate n, the average number of spills for a ten-day response cycle time for each site. The last column, in Table 5-8, under "units" shows the number of response units required to achieve a 90 percent response capability, i.e., to give a steady-state probability P (r, n) of .90 that a response unit will be available when a respondable spill occurs, assuming that a respondable spill requires one, and only one, unit. This is approximately true for response vans, but not correct for offloading units. Thus, the Table gives the number of vans required for .90 or greater availability. This requirement for number of vans is based on several assumptions that are here repeated:

(1) Spills will occur randomly in time at the average rate of the last four years of PIRS data, 1976-79.

(2) Only respondable spills are counted, i.e., those with spill volumes at or above the threshold levels listed in Appendix C1.

(3) The response cycle times are exponentially distributed with a mean value of 10 days.

The first of these assumptions is considered conservative, because the 1976-79 PIRS spill rate is unlikely to increase substantially in 1980-1985, for the reason outlined in Section 3. Moreover, the respondable spill rate is stabilizing to about 10 percent-11 percent of the total PIRS spill rate, as seen in Figure 5-4; and the total spill rate may actually decline in 1980-85.

TABLE 5-7. BREAKDOWN BY YEAR AND USCG DISTRICT OF PIRS AND MTB 'RESPONDABLE' SPILLS

SPILL YEAR	DT 01	DT 03	DT 05	RG EC	DT 07	DT 08	RG GC	DT 11	DT 12	DT 13	RG WC	DT 02	DT 09	RG IG	DT 14	DT 17	RG AP	ALL TOTAL	DATA BASE
1976	4	14	7	25	3	9	12	2	4	4	10	34	22	56	0	1	1	104	MTB
1977	2	18	6	26	5	18	23	9	6	7	22	33	20	53	0	3	3	127	MTB
1978	6	15	5	26	4	17	21	6	3	20	29	31	27	58	1	0	1	135	MTB
1979	2	11	4	17	6	18	24	8	11	9	28	37	19	56	0	0	0	125	MTB
TOTAL	14	58	22	94	18	62	80	25	24	40	89	135	88	223	1	4	5	491	
X	3.50	14.50	5.50	23.50	4.50	15.50	20.00	6.25	6.00	10.00	22.25	33.75	22.00	55.75	0.25	1.00	1.25	122.75	
S.D.	1.91	2.89	1.29	4.36	1.29	4.36	5.48	3.10	3.56	6.98	8.73	2.50	3.56	2.06	0.50	1.41	1.26	13.23	
1973	2	13	0	15	8	7	15	2	5	2	9	11	7	18	0	0	0	57	PIRS
1974	1	10	5	16	4	15	19	3	2	1	6	14	10	24				65	PIRS
1975	1	16	3	20	7	9	16	6	12	2	20	22	9	31				87	PIRS
1976	2		7	19	3	14	17	10	8	7	25	39	16	55				116	PIRS
1977	3	18	16	37	8	17	25	2	9	4	15	38	11	49				126	PIRS
1978	6	23	8	37	4	20	24	5	7	2	14	29	11	40				115	PIRS
1979	1	19	11	31	8	14	22	0	2	4	6	35	7	42				101	PIRS
TOTAL	16	109	50	175	42	96	138	28	45	22	95	188	71	259	0	0	0	667	7 years
X	2.29	15.57	7.14	25.00	6.00	13.71	19.71	4.00	6.43	3.14	13.57	26.86	10.14	37.00	0	0	0	95.29	
S.D.	1.80	4.86	5.27	9.71	2.24	4.46	3.99	3.32	3.69	2.04	7.28	11.42	3.08	13.34	0	0	0	26.60	
TOTAL	12	70	42	124	23	65	88	17	26	17	60	141	45	186	0	0	0	458	4 years
X	3.00	17.50	10.50	31.00	5.75	16.25	22.00	4.25	6.50	4.25	15.00	35.25	11.25	46.50	0	0	0	114.50	
S.D.	2.16	5.45	4.04	8.49	2.63	2.87	3.56	4.35	3.11	2.06	7.79	4.50	3.69	6.86	0	0	0	10.28	

TABLE 5-8. PROBABILITY P(r,n) OF NON-RESPONSE FOR SITE CONFIGURATIONS OF TABLES 5-4, 5-5, 5-6

SITE NAME	SPILLS PER 10 DAYS r	Probability of Non-Response for n = 1	2	3	4	5	6	Units[1]
SINGLE-SITE CONFIGURATION								
Elizabeth City, NC	2.96	1.00	1.00	1.00	0.380	0.145	0.050	6
STRIKE TEAM CONFIGURATION								
Elizabeth City, NC	1.93	1.00	1.00	0.300	0.085	0.026	0.006	4*
Bay St. Louis, MS	.60	0.360	0.042	0.005				2
Hamilton AFB, CA	.44	0.200	0.018	0.002				2
	2.96							8
11-SITE CONFIGURATION								
Boston, MA	.08	0.007						1
New York, NY	.39	0.160	0.013	0.001				2
Gloucester City, NJ	.15	0.023						1
Elizabeth City, NC	1.31	1.00	0.350	0.075	0.017	0.003		3*
Miami, FL	.16	0.026	0.001					1
Bay St. Louis, MS	.19	0.036	0.001					1
Galveston, TX	.24	0.060	0.003					1*
Long Beach, CA	.13	0.017						1
Hamilton AFB, CA	.21	0.040	0.002					1
Seattle, WA	.10	0.010						1
Kodiak, AK	---							—
	2.96							13
MODIFIED 11-SITE CONFIGURATION								
New York, NY	.46	0.220	0.019	.002				2
Gloucester City, NJ	.15	0.023						1
Elizabeth City, NC	.17	0.029	0.001					1
Bay St. Louis, MS	.35	0.125	0.009					2
Galveston, TX	.24	0.060	0.003					1
Long Beach, CA	.13	0.017						1
Hamilton AFB, CA	.31	0.095	0.007					1*
Paducah, KY	.37	0.140	0.011	.001				2
Toledo, OH	.35	0.125	0.009					2
Pittsburgh, PA	.14	0.020						1
Cincinnati, OH	.28	0.080	0.005					1
	2.96							15

TABLE 5-8. PROBABILITY P(r,n) OF NON-RESPONSE FOR SITE CONFIGURATIONS OF TABLES 5-4, 5-5, 5-6 (CONT.)

SITE NAME	SPILLS PER 10 DAYS r	Probability of Non-Response for n = 1	2	3	4	5	6	UNITS[1]
SEVEN-SITE CONFIGURATION								
New York, NY	.39	0.160	0.013	0.001				2
Gloucester City, NJ	.15	0.023						1
Elizabeth City, NC	1.55	1.000	0.510	0.130	0.034	0.007	0.002	4
Bay St. Louis, MS	.19	0.039	0.002					1
Galveston, TX	.24	0.060	0.003					1
Long Beach, CA	.13	0.017						1
Hamilton AFB, CA	.31	0.095	0.007					1*
	2.96							11
MODIFIED 11-SITE CONFIGURATION WITH AIR								
New York, NY	.39	0.160	0.013	0.001				2
Gloucester City, NJ	.15	0.023						1
Elizabeth City, NC	.99	1.00	0.170	0.029	0.005			3
Bay St. Louis, MS	.19	0.039	0.002					1
Galveston, TX	.24	0.060	0.003					1
Long Beach, CA	.13	0.017						1
Hamilton AFB, CA	.31	0.095	0.007					1*
Pittsburgh, PA	.14	0.020						1
Louisville, KY	.14	0.020						1
Huntington, WV	.14	0.020						1
Toledo, OH	.14	0.020						1
	2.96							14

[1] Number of response units required for probability of non-response .10 or less.

*Adding one more unit at the site will reduce probability of non-response to .05 or less.

The second assumption is arbitrary in that the levels used to define 'respondable' spills were set judgmentally, since the existing data are inadequate to cover most of the chemicals that appear in the PIRS files. Despite its judgmental character, the agreement with experience is encouraging: the 'respondable' spill rate for Bay St. Louis seen in Table 5-8 under the (present) Strike Team Configuration is about 22/year; while actual experience shows it to have peaked at about 15-16/year in the 1976-79 period. The assumption, therefore, is probably slightly conservative.

The third assumption, regarding response cycle time, is also arbitrary, but based on estimates by field personnel. Their experience is likely to have been based on (a) the very largest spills responded to, and (b) ground response instead of air and ground response. If the USCG chemical spill response capability is expanded it is likely that the mean response time will drop because a larger number of small spills will be responded to, and because of improved logistics. Therefore, this assumption is also considered to be conservative.

Because of the safety margins built into the above three assumptions, a response unit availability of 90 percent is considered adequate for design purposes; the number of units shown in the last column of Table 5-8 will be taken as the number required at each site.

5.5 EVALUATION OF BASE CONFIGURATIONS

5.5.1 Evaluation Measures

In order to evaluate the six candidate configurations, it is necessary to assign a cost measure to each. Although an accurate costing analysis was not undertaken, an effective evaluation can be achieved on the basis of relative costs of the various configurations.

To establish relative costs it is necessary to reduce all cost elements to a common denominator. The most convenient one is the single response van, because almos~ all cost items are proportional to the number of vans deployed. In detail, the following cost items were assumed to be proportional to the number of vans:

(1) Equipment: The equipment complement for a van was described in Section 4. Although the final equipment selection may vary from that shown, it

is assumed that all vans will be similarly equipped, for several reasons. First, uniform furbishing simplifies training, e.g., by making it possible to produce a single training manual for all sites. Further, a single van layout can lead to economies in purchasing, since all van purchases can be grouped into a single procurement, thus reducing the per unit contractual cost, and gaining the advantage of wider competitive bidding. Finally, uniform equipment arrangement in the van improves the safety of a response operation by making it easier to identify pieces of equipment and to detect lost or expended items rapidly.

(2) Personnel Costs: It is assumed that at single-van sites chemical response will be performed by a team of fixed composition (about 20). At low intensity sites (i.e., sites at which respondable spills are less than, say, one per month) most of these personnel will have other duties as well as chemical spill response. For example, the 20-man team at one of the 11 pollution response bases will have oil spill response duties as well as chemical spill response duties. If the site is not a general pollution response site, these other duties will lie in other mission areas.

At sites housing more than one chemical response van , each additional van is assumed to require an additional team. These teams must be distinct, i.e., two part-time teams cannot be combined into one full-time team, for then the number of teams, rather than the number of vans, would be the limiting factor in response availability; an analysis identical to that above for vans would lead to the same numerical requirements for teams.

Therefore, in either the single-van or multiple-van case, the personnel complement is assumed to be proportional to the number of vans.

(3) Storage areas, repair facilities: In these cases, the true cost may be non-linear with the number of vehicles, since there is often an overhead incurred with the establishment of the garage or repair shop. In some cases, the storage facilities already exist, or can be rented at a per-square-foot cost, thus leading to no cost or to proportional costs. Given the spectrum of possibilities, the proportionality assumption cannot be considered conservative or non-conservative.

(4) Replacement costs: It is assumed that use life is time-dependent rather than use-dependent. This may not be accurate for one of the major cost items, encapsulating suits, because of the build-up of chemical contaminants.

But other factors, such as obsolescence, wear in training and handling, and deterioration due to sunlight exposure and temperature cycling, tend to be time- rather than use-dependent.

Since each site configuration is assumed to service the same total demand (about 108 spills per year) the outputs of all configurations are equal. The service availability, however, varies slightly from configuration to configuration, being better than 90 percent for all configurations. The response time, however, does vary substantially from configuration to configuration (see Tables 5-4, 5-5, and 5-6).

5.5.2 Evaluation

The main performance numbers developed for the six configurations are:

Mean Response Time

Maximum Response Time

Probability of Non-Availability

Number of Response Units.

The first three are plotted against the fourth in Figure 5-5 for the six configurations:

(1) One-Site Configuration

(3) Strike Team Configuration

(7) Seven-Site Configuration

(11) 11-Site Configuration

(M 11) Modified 11-Site Configuration

(M 11 A) Modified 11-Site Configuration with Air

The probability of non-availability was calculated from the probabilities shown in Table 5-8 for the number of units in the last column, weighted by the 10-day spill rate of the first column for each site in the configuration.

From Figure 5-5 it is seen that the Strike Team Configuration (3) is inferior to the Single Site Air Configuration (1) in both maximum response time and probability of non-availability. Moreover, it is only marginally superior in mean response time, even though it requires two more response vans.

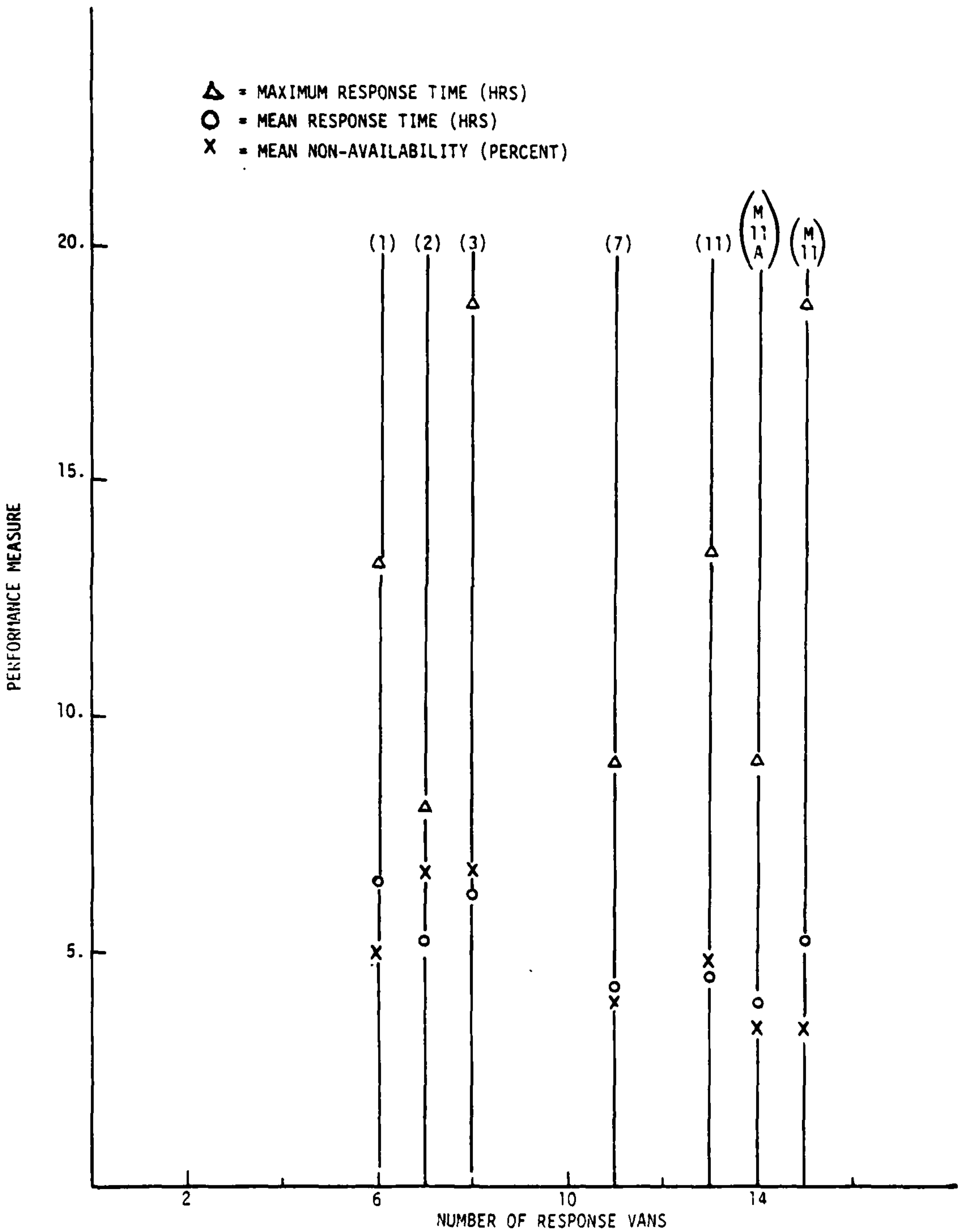


FIGURE 5-5. PERFORMANCE MEASURES FOR SITE CONFIGURATIONS

Further it is seen that the 11-Site (11) and Modified 11-Site (M 11) Configurations are inferior to the Seven-Site Configuration (7), except that the Modified 11-Site Configuration has a lower non-availability measure. This slight improvement is hardly adequate to justify the extra 4 vans it entails.

Finally, it is seen that the Modified 11-Site Configuration with Air support (M 11 A) is slightly superior to the Seven-Site Configuration in mean response time and mean non-availability, and equal to it in maximum response time. If total cost is taken to be proportional to the number of vans required, then the M 11 A configuration offers a 9 percent reduction in mean response time and non-availability for a 27 percent increase in cost. On that basis, the Seven-Site Configuration is preferred.

The above discussion, then, leads to the elimination of all but two candidate configurations: the Single-Site Configuration and the Seven-Site Configuration. The process of elimination, it should be noted, was based not so much on clear-cut differences in response times or availabilities, as in the lack of such differences for clearly greater investments in equipment. The two remaining configurations now will be examined in more detail.

Single-Site Configuration

This configuration has superior performance measures than the present 3-Strike Team Configuration, primarily because it assumes air servicing of the Georgia-Florida and Galveston-Houston areas. One weak point is the trans-continental flights required of the C130B aircraft from Elizabeth City to the west coast. Perhaps the most serious disadvantage is that the six response units could place heavy demands on the four C130B aircraft available at Elizabeth City, NC. The demand for chemical spill response may interfere with SAR and other air missions out of that base. A more practical arrangement is a two-site configuration, Hamilton AFB and Elizabeth City, NC. The performance for such a configuration is shown in Table 5-9. A total of seven vans is required, five on the east coast and two on the west. The performance indices are shown in Figure 5-5 between those for the single site and the 3-site configurations. The Two-Site Configuration is considered more practical than the Single-Site Configuration because of the more even distribution of loading on the C130's. It also provides service to Alaska and Hawaii, which is lacking in the Single-Site Configuration.

TABLE 5-9. TWO-SITE CONFIGURATION[1]

RESPONSE TIMES

NAME OF SITE (CITY)	RESPONDABLE SPILLS, '73-'79 PIRS	MEAN RESPONSE (hours)	MAXIMUM RESPONSE (hours)
*Elizabeth City, NC	537	5.45	8.1
*Hamilton AFB, CA	94	4.27	6.5
	631	5.27	8.1

PROBABILITY OF NON-RESPONSE

	SPILLS PER 10 DAYS	Probability of Non-Response for 1	2	3	4	5	6	Units
*Elizabeth City, NC	2.52	1.00	1.000	.60	.22	.075	.023	5
*Hamilton AFB, CA	.44	0.20	0.017					2
	2.96							

(1) Response times do not include Alaska, Hawaii or Puerto Rico.

*Response by air when lower response times result.

Seven-Site Configuration

This configuration also derives its strengths from the reliance on air response for relatively remote areas. It can be improved by the addition of four sites interior to the U.S., which adds only three vans because the van requirement at Elizabeth City drops from 4 to 3. This is the Modified 11-Site Configuration with Air support. The Seven-Site Configuration offers improvements in mean response time and non-availability over the Two-Site Configuration, but has a slightly higher maximum response time. It has the advantage that all sites are coincident with present or planned pollution response bases. It also provides coverage of Alaska and Hawaii from San Francisco. But it places a substantial response load on 4 vans at Elizabeth City, NC, which would respond to about 52 percent of the spills in the U.S.

5.6 SELECTION OF CONFIGURATION AND NUMBERS OF RESPONSE UNITS

The present hazardous chemical spill response capability is centered at the Three Strike Teams. The above analysis shows that if the air response times estimated in Section 5.3 are realized in practice, then superior performance can be obtained from two bases. The air response times were estimated on the basis of the C130's being available from SAR status and on the assumption that the equipment is pre-loaded into air transportable response vans. If the reaction times estimated in Section 3 are not realized then configurations (1), (2), (3), (7) and (M 11 A) will have worse performance indices than shown in Figure 5-5, and configurations (11) and (M 11) will be preferred. These two configurations, however, require a greater investment than the others (except M 11 A).

Given the present Strike Team Configuration, then, either of two courses of development can provide improved response effectiveness: Both presuppose an air response capability.

A: Expand to Seven-Site Configuration: This configuration calls for 11 vans at 7 sites, including the three Strike Team sites. Rapid air response at the two air bases is essential, particularly at Elizabeth City.

All seven bases are among the 11-site oil pollution response configuration and should share resources with that program.

B: <u>Contract to Two Air Sites</u>: If resources are too limited to allow implementation of 7 sites, then an improved capability can still be acquired by strengthening the air capability to deliver hazchem response equipment on each coast. This will achieve reduced response times by expanding the area covered by Elizabeth City to include the entire eastern U.S. This configuration calls for 5 units at Elizabeth City and 2 at Hamilton AFB.

The total number of vans called for in either course is based on the 1976-1979 PIRS 'respondable' spill rate as defined in Appendix C1. This rate is slightly above that actually observed but may be closer to what will occur when the full Coast Guard capability is realized, and they are called upon in a wider variety of situations. As experience is gained, a more accurate estimate may be made of the respondable spill rate and the mean response cycle time, and the number of vans required reestimated.

6. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The study was directed to U.S. coastal and waterway counties and to hazardous substances other than non-flammable oils. The three steps of the methodology produced the results summarized here in qualitative form, detailed data being contained in the Sections indicated:

Assess the Non-USCG Capability for Hazardous Chemical Spill Response (Section 2)

1. Because the assessment was not based on a comprehensive survey, the potential for error is great. The error is estimated to be -50% and +100%. The results relative to the U.S. Coast Guard are:

- o EPA's strongest capability is in technical advice and detection and identification equipment.
- o DOD has substantial equipment at its various bases for response to fire, Nuclear/Bacteriological/Chemical releases, for fuel handling and for explosion control.
- o Local governments are usually well equipped for fire and communications, but lack most other resources.
- o The Chlorine Emergency Plan (CHLOREP), the National Agricultural Chemicals Association (NACA), and other trade organizations as well as the manufacturers themselves provide extensive response capability for specific chemicals.
- o Chemical offloading equipment, such as pumps, trucks, and tanks appeared in few numbers in the survey, but a few commercial firms have large fleets of offloading vehicles.

2. The Spill Cleanup Inventory System (SKIM) provided about 25% of the total survey list. It is weak in chemical response gear and especially deficient in protective gear. A sample of the SKIM list shows it to contain about 5% of the protective clothing and breathing apparatus in the First District.

3. Over half of the protective gear and instrumentation in the survey is contained in the coastal and waterway counties. But a more specific

geographic distribution can not be determined because the assessment was not comprehensive.

4. The assessment indicated that the national capability is approximately 59% with commercial contractors, 33% with private organizations, and 8 percent with Federal, State and local agencies.

<u>Determine the Frequency and Geographic Distribution of Hazardous Chemical Spills in the United States</u> (Section 3)

1. The Materials Transportation Bureau (MTB) data are representative of highway, rail and air mode spills; the Pollution Incident Reporting System (PIRS) data cover water and facility spills. There is less than 0.5 percent overlap of the two data bases.

2. There is also poor overlap of the two data bases with regard to the types of chemicals reported spilled.

3. About 60 percent of the spills reported by MTB, and over 80% of the spills reported by PIRS, are flammable liquids.

4. Comparison of chemicals in the two data bases shows poor correspondence between them, or between either and the Chemical Hazard Response Information System (CHRIS) codes employed by the Coast Guard. (See Reference 5, Table 3.)

5. The MTB data show a rapid increase from 1971 through 1978, but this can be attributed to an increase in reporting, rather than to an increase in spills.

6. The PIRS data show an increase in the number of 'respondable' spills from 1973 to 1977 but a slight drop from 1977 to 1979.

7. Chemical spill incidents are not uniformly distributed along the coast and waterways, but cluster in industrial and population centers.

8. The incidents of spills listed in PIRS without regard to quantity released are evenly divided among the East, Gulf and West coasts, and the Central U.S. But when only spills of size above 'respondable' levels are considered, the Central U.S. has experienced about 40% of incidents, compared to 14%-26% for the three coastal areas. (Table 5-2.)

Determine the Types, Quantities and Locations of U.S. Coast Guard Equipment Required to Respond to Spills of Hazardous Chemicals

TYPES (Section 4)

1. An analysis of historical 'respondable' spills showed that 78% of them called for Self-Contained Breathing Apparatus, 57% needed neoprene protective splash suits, and 17% neoprene boots and gloves.

2. A complement of equipment for a 20-man response team comprising instrumentation, protective clothing, respiratory equipment, communications, and light support equipment, occupies about 1100 cubic feet, weighs about 12,000 lbs and can be fit into a single van that can be transported by a Coast Guard C130 aircraft.

3. A selection of offloading equipment can be made that fits onto a 32 ft, air transportable, low bed semi-trailer of the type currently used by the Coast Guard for oil spill response.

NUMBER AND LOCATION (Section 5)

1. Air-based Strike Teams at Elizabeth City, NC and Hamilton AFB, CA alone provide more rapid response than when a third Strike Tream serves the 7th and 8th Districts by land from Bay St. Louis. (Table 5-9, Two-Site Configuration compared to Table 5-4, Strike-Team Configuration.)

2. Hazchem spills in the Central U.S. are reached more rapidly by air from Elizabeth City, NC, than by land from Toledo, OH, Pittsburgh, PA, Cincinatti, OH and Paducah, KY. (Table 5-5, Seven-Site Configuration compared with Table 5-4, Modified 11-Site Configuration.)

3. The response times for the seven configurations evaluated are (Tables 5-4, 5-5, 5-6, 5-9):

(#) Configuration	Response Times (hours) Mean	Maximum
(1) Single-Site	6.58	13.3
(2) Two-Site	5.27	8.1
(3) Strike Team	6.24	18.8
(4) Seven-Site	4.32	9.1
(5) 11-Site	4.49	13.3
(6) Modified 11-Site	5.34	18.8
(7) Modified 11-Site with Air	3.93	9.1

4. When the number of response vans is considered as well as the response times, the Two-Site Configuration (2) is preferred to Configuration (1) and (2), and the Seven-Site Configuration (4) is preferred to all others, except, perhaps, Configuration (7).

RECOMMENDATIONS

1. The SKIM system should be expanded in the area of hazchem response equipment. This would not only strengthen the On-Scene Coordinator's access to resources outside of his immediate area, but would also aid the proper deployment of USCG resources. Attention should be given to inclusion of EPA, DOD, and specialized industry capabilities. The expanded SKIM list should be a key element in the effective utilization of private contractors and other non-USCG hazchem response capability.

2. The development of a USCG air-based hazchem response capability should be pursued, because it can provide lower response times with fewer response units than land-only capability. The goals should be

- development of an air-transportable hazchem response van similar to that described in Section 4.
- achievement of the response times estimated in Section 5.3 based on the present C130 aircraft.
- integration of the air response capability into local and regional contingency plans.

3. Assuming the air response capability is achieved, expansion of the total USCG hazchem response capability should aim first at the Seven-Site Configuration, and then at the Modified 11-Site Configuration with Air support. Specifically, the following stages are suggested:

- Development of air response capability with 2 units at Elizabeth City, NC, one at Hamilton AFB, CA, plus one ground unit at Bay St. Louis. The latter unit would cover the Gulf coast from MSO Mobile to MSO Port Arthur.
- Expansion to eight units by the addition of one ground van each at New York, Galveston, Long Beach and Gloucester City.

- o Expansion to the full 11 units called for in the Seven-Site Configuration, contingent on the actual experience regarding (a) respondable spill rate, and (b) response cycle time.

- o Addition of 4 sites in Central U.S., at Toledo, Pittsburgh, Huntington and Louisville, yielding the Modified 11-Site Configuration.

Offloading units are not included in the above outline, but it is suggested that initially one offloading semi-trailer be stationed at each of the two air bases. Contingent on the demand for, and experience in their use, additional semi-trailers would be stationed at (in order): New York, Galveston, Bay St. Louis, and Elizabeth City. An additional requirement for deploying the offloading units to any site is that tractor(s) have already been stationed at the site for oil pollution response or other duty.

4. If expansion of the present site configuration is not possible within available funds, then it is recommended that the air response capability still be developed, with the objective of the Two-Site Configuration of Table 5-9. This Configuration provides relatively good response and availability with only 7 units. The stages suggested are:

- o Development of air response capability with two units at Elizabeth City and one at Hamilton AFB. The present Gulf Strike Team would be retained.

- o Addition of two more units at Elizabeth City and one more at Hamilton AFB, still converting the Bay St. Louis unit to air-transportable form.

- o Transfer of the Gulf Strike Team unit to Elizabeth City.

Offloading semi-trailers would be phased in at Elizabeth City (2 units) and Hamilton AFB (1 unit).

5. If air transport capability is not available for the hazchem response equipment, then the first recommended objective is the Modified 11-Site Configuration. The response times for 15 units, shown in Table 5-8 and 5-4, however, will not be achieved. To bring response times down to the levels of the seven configurations shown in Table 5-4 would require expansion to more than 11 sites and, probably, more than 15 units. This course of action has not been investigated in detail because it is considered to be less cost-effective than development of an air-response capability.

REFERENCES

1. Report Number CG-D-14-79, "Deployment Requirements for U.S. Coast Guard Pollution Response Equipment," U.S. Department of Transportation, Research and Special Projects Administration, Transportation Systems Center, Cambridge, MA 02142, February 1979.

2. CG-450, "Pollution Incident Reporting System, Coding Instruction Manual," February 1976, Department of Transportation, Coast Guard.

3. Report No. CG-123-1, Project Memorandum, CG-123, "Analysis of Hazardous Chemical Spills along the Coasts and Major Waterways of the United States," U.S. Department of Transportation, Research and Special Projects Administration, Transportation Systems Center, Cambridge, MA 02142.

4. Report No. CG-123-2, "Hazardous Material Pollution Response Resource Assessment," U.S. Department of Transportation, Research and Special Projects Administration, Transportation Systems Center, Cambridge, MA, 02142.

5. Report No. CG-023-1, Project Memorandum, CG -23, "Interim Report on Coast Guard Related Chemical Spill Data," September 1980, U.S. Department of Transportation, Research and Special Projects Administration, Transportation Systems Center, Cambridge, MA 02142.

6. "Program Plan for the USCG Marine Environmental Protection Program, FY83-92", G-WEP-1, February 1980.

7. "Survey of Personnel Protective Clothing and Respiratory Apparata for use by Coast Guard Personnel in Response to Discharges of Hazardous Chemicals," W.M. Hammer, et.al., U.S. Coast Guard Report No. CG-D-89-75, September 1974. NTIS AD A010110.

8. "Policy Guidance for Response to Hazardous Chemical Discharges," U.S. Coast Guard COMDTINST 16465.16, 16 May 1979.

9. "Responding to Casualties of Ships Bearing Hazardous Cargoes", Marine Board, Assembly of Engineering, National Research Council, National Academy of Sciences, Washington DC, 1979, AD-A075203.

10. "Recommended System for the Identification of Fire Hazards of Materials, NFPA No. 704M". National Fire Protection Association, Boston MA, 02210.

11. "Hazardous Chemical Data, 1975", NFPA 49, National Fire Protection Association, Boston MA, 02210.

12. "Application of Foams to Hazardous Chemical Spills", S.S. Gross, Proceedings of the 1980 National Conference on Control of Hazardous Material Spills, Vanderbilt University, Nashville, TN.

13. AD-776-618, "Bulk Transportation of Hazardous Materials by Water in the Future - A Long Range Forecast," National Academy of Sciences, July 1973.

14. "Mathematical Methods of Operations Research," T.L. Saaty, McGraw Hill Book Co., New York, 1959, p. 359-360.

APPENDIX A

DEFINITION OF AREA FOR HAZARDOUS CHEMICAL RESPONSE STUDY

The study area definition was evolved from consultation with the Coast Guard and from computational considerations. It was decided to limit the study to coastal regions, major "navigable waterways," and the Great Lakes. As a working definition of "navigable waters," it was decided to take all waterways of nine or more feet in depth, with substantial commerce. As an indicator of "substantial commerce", a minimum annual petroleum movement of 1,000,000 short tons was adopted. The resulting waterways are listed in Table A-1.

In order to clearly define the shorelines adjacent to coasts, waterways and the Great Lakes, it was found to be most practical to employ the boundaries of the counties contiguous to the shorelines. County data are easily obtained from the HMIR spill records and can be determined from the latitude and longitude given in the PIRS data base. Moreover, county boundaries for all counties in the U.S., are available in computerized form at the Transportation Systems Center, where they have been plotted on maps of the continental United States. Although the data base provided information on spills which have occurred in Alaska, Hawaii, Puerto Rico and the Virgin Islands, maps for these areas were not produced.

In summary, then, the study area was taken to be all counties adjoining the East, West and Gulf coasts, "navigable waterways of substantial commerce," the Great Lakes, and the costs of Alaska, Hawaii, Puerto Rico and the Virgin Islands.

This Appendix gives the names of the selected waterways, gives the number of counties found in each Coast Guard district, and gives the name of each Coast Guard-related county. Figure A-1 is a map of the continental United States, showing in outline, state boundaries and each county relevant to the study. (Actual spill maps appear in Section 3. Table A-2 shows the number of coastal counties in each Coast Guard District. Table A-3 is a complete list of the coastal and waterway counties defining the study area. Each was given a 5-digit code, according to the scheme shown at the front of the Table in parentheses.

TABLE A-1 NAVIGABLE WATERWAYS EMPLOYED FOR USCG SPILL RESPONSE ANALYSIS

Inland Waterways

1. Lower Mississippi, from mouth of Ohio River down to, but not including Baton Rouge, LA.

2. Upper Mississippi, Minneapolis, MN to mouth of Ohio River

3. Illinois River, from Lockport IL, to mouth

4. Ohio River System, comprising

   - Ohio River, from Pittsburgh, PA to mouth

   - Cumberland River, mouth to mile Nashville, TN

   - Tennessee River, mouth to Knoxville

   - Allegheny River, Pittsburgh, PA to East Brady, PA

   - Monongahela River, Pittsburgh, PA to Fairmont, WV

   - Kanawha River, mouth to Charlestown, WV.

Coastal Waterways

Atlantic Coastal waterways and rivers

1. Penobscot River, mouth to Bangor, ME

2. Cape Cod Canal

3. Connecticut River below Hartford, CT

4. Hudson River, New York Harbor to Waterford, NY

5. Delaware River, Trenton, NJ to sea

6. Washington Harbor DC and Potomac River below DC

7. James River, VA to Richmond, VA

8. York River, VA to West Point, VA.

Gulf Coast Waterways and Rivers

1. Calcasieu River and Pass, LA (Lake Charles, LA)

2. Sabine-Neches Waterway (Beaumont, Orange, P. Arthur)

3. Houston Ship channel, TX

4. Texas City channel, TX

5. Mississippi River, Baton Rouge to the Sea, LA

Great Lakes Waterways and Rivers

1. Chicago Sanitary and Ship Canal, Lockport, IL to Lake Michigan

West Coast Waterways and Rivers

1. San Francisco Bay, Suisan Bay Channel, Carquinez Strait, Marie Island Strait, San Pablo Bay, San Jaoquin River (mouth to Stockton, CA), Oakland, Richmond, CA

2. Columbia River, mouth to Portland, OR

3. Puget Sound (Tacoma and Seattle, WA).

The above rivers and waterways are in addition to coastal and Great Lakes ports and harbors, the Alaskan Coast, and coastal waters of: Hawaii, Puerto Rico, and the Virgin Islands.

Figure A-1. OUTLINE MAP OF U.S., SHOWING COUNTIES IN STUDY AREA

U. S. COAST GUARD RELATED COUNTIES

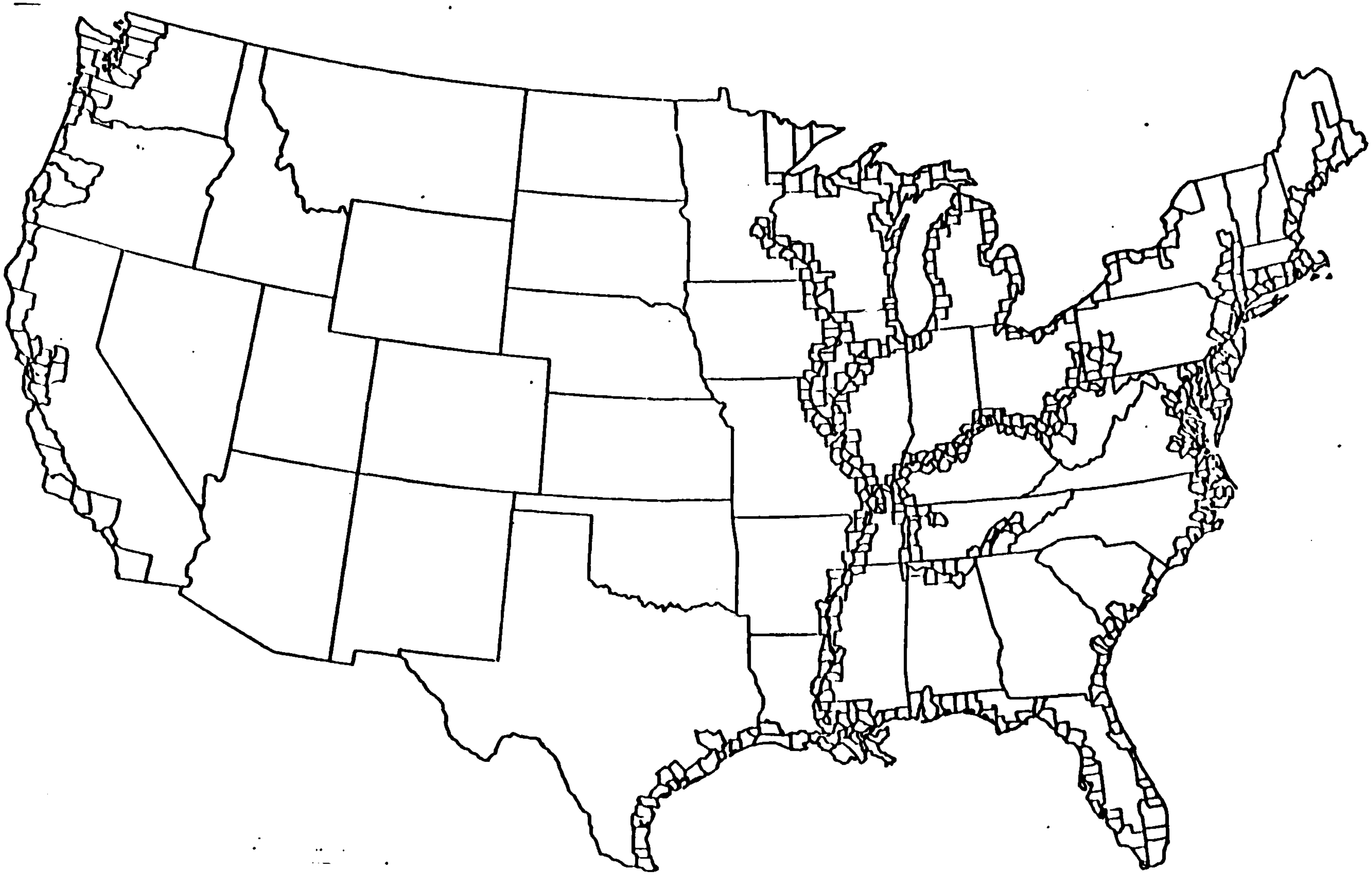


TABLE A-2 COAST GUARD RELATED COUNTIES

C.G. DISTRICT NO.	NUMBER OF COUNTIES
1	24
2	209
3	44
5	70
7	43
8	62
9	84
11	4
12	18
13	25
14	4
17	25
TOTAL	612

TABLE A-3 U.S. COAST GUARD RELATED COUNTY INDEX CODES

	NUMBER OF COUNTIES	COAST GUARD DISTRICT
A. COASTAL AND COAST WATERWAY: (10000)	(307)	
I. (11000) - Atlantic coast and waterway	138	1, 3, 5
II. (13000) - South Atlantic and Gulf coast and waterway	91	7.8
III. (15000) - Pacific coast and waterway	47	11, 12, 13
IV. (17000) - Alaska coast	25	17
V. (18000) - Hawaii coast	4	14
VI. (19000) - Puerto Rico and Virgin Islands coast	2	7
B. INLAND WATERWAY: (30000)	(221)	
I. (31000) - Lower Mississippi River	34	2, 8
II. (32000) - Upper Mississippi River	58	2
III. (33000) - Illinois River	17	2
IV. (34000) - Ohio River	70	2
V. (35000) - Cumberland River	7	2
VI. (36000) - Tennessee River	26	2
VII. (37000) - Allegheny River	2	2
VIII. (38000) - Monogahela River	5	2
IX. (39000) - Kanawha River	2	2
C. GREAT LAKE WATERWAY AND RIVERS: (50000)	(84)	
I. (51000) - Lake Superior	17	9
II. (53000) - Lake Michigan	34	9
III. (55000) - Lake Huron	11	9
IV. (57000) - Lake Erie	14	9
V. (58000) - Lake Ontario	7	9
VI. (59000) - St. Lawrence River	1	9
TOTAL:	(612)	

REVISED Jan. 1, 1981

COAST GUARD RELATED COUNTY CODE

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME	CG DT
10000				COASTAL AND COAST WTRWAY	
11000				ATLANTIC COAST + WTRWAY	
11001	23	ME	029	WASHINGTON	01
11002	23	ME	009	HANCOCK	01
11003	23	ME	019	PENOBSCOT	01
11004	23	ME	027	WALDO	01
11005	23	ME	013	KNOX	01
11006	23	ME	015	LINCOLN	01
11007	23	ME	023	SAGADAHOC	01
11008	23	ME	005	CUMBERLAND	01
11009	23	ME	031	YORK	01
11010	33	NH	017	STRAFFORD	01
11011	33	NH	015	ROCKINGHAM	01
11012	25	MA	009	ESSEX	01
11013	25	MA	025	SUFFOLK	01
11014	25	MA	021	NORFOLK	01
11015	25	MA	023	PLYMOUTH	01
11016	25	MA	001	BARNSTABLE	01
11017	25	MA	019	NANTUCKET	01
11018	25	MA	007	DUKES	01
11019	25	MA	005	BRISTOL	01
11020	44	RI	005	NEWPORT	01
11021	44	RI	001	BRISTOL	01
11022	44	RI	007	PROVIDENCE	01
11023	44	RI	003	KENT	01
11024	44	RI	009	WASHINGTON	01
11025	09	CT	011	NEW LONDON	03
11026	09	CT	007	MIDDLESEX	03
11027	09	CT	009	NEW HAVEN	03
11028	09	CT	003	HARTFORD	03
11029	09	CT	001	FAIRFIELD	03
11030	36	NY	005	BRONX	03
11031	36	NY	119	WESTCHESTER	03
11032	36	NY	087	ROCKLAND	03
11033	36	NY	079	PUTNAM	03
11034	36	NY	071	ORANGE	03
11035	36	NY	027	DUTCHESS	03
11036	36	NY	111	ULSTER	03
11037	36	NY	039	GREENE	03
11038	36	NY	021	COLUMBIA	03
11039	36	NY	001	ALBANY	03
11040	36	NY	083	RENSSELAER	03
11041	36	NY	091	SARATOGA	03
11042	36	NY	103	SUFFOLK	03
11043	36	NY	059	NASSAU	03
11044	36	NY	081	QUEENS	03
11045	36	NY	047	KINGS	03
11046	36	NY	061	NEW YORK	03
11047	36	NY	085	RICHMOND	03
11048	34	NJ	003	BERGEN	03
11049	34	NJ	017	HUDSON	03
11050	34	NJ	013	ESSEX	03
11051	34	NJ	039	UNION	03
11052	34	NJ	023	MIDDLESEX	03

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME	CG DT
11053	34	NJ	025	MONMOUTH	03
11054	34	NJ	029	OCEAN	03
11055	34	NJ	005	BURLINGTON	03
11056	34	NJ	001	ATLANTIC	03
11057	34	NJ	009	CAPE MAY	03
11058	34	NJ	011	CUMBERLAND	03
11059	34	NJ	033	SALEM	03
11060	34	NJ	015	GLOUCESTER	03
11061	42	PA	045	DELAWARE	03
11062	34	NJ	007	CAMDEN	03
11063	42	PA	101	PHILADELPHIA	03
11064	42	PA	017	BUCKS	03
11065	34	NJ	021	MERCER	03
11066	10	DE	003	NEW CASTLE	03
11067	10	DE	001	KENT	03
11068	10	DE	005	SUSSEX	03
11069	24	MD	047	WORCESTER	05
11070	51	VA	001	ACCOMACK	05
11071	51	VA	131	NORTHAMPTON	05
11072	24	MD	039	SOMERSET	05
11073	24	MD	045	WICOMICO	05
11074	24	MD	019	DORCHESTER	05
11075	24	MD	041	TALBOT	05
11076	24	MD	035	QUEEN ANNES	05
11077	24	MD	029	KENT	05
11078	24	MD	015	CECIL	05
11079	24	MD	025	HARFORD	05
11080	24	MD	510	BALTIMORE CITY	05
11081	24	MD	005	BALTIMORE	05
11082	24	MD	003	ANNE ARUNDEL	05
11083	24	MD	009	CALVERT	05
11084	24	MD	037	ST. MARYS	05
11085	24	MD	017	CHARLES	05
11086	51	VA	153	PRINCE WILLIAM	05
11087	51	VA	179	STAFFORD	05
11088	51	VA	059	FAIRFAX	05
11089	24	MD	033	PRINCE GEORGES	05
11090	11	DC	001	WASHINGTON	05
11091	51	VA	099	KING GEORGE	05
11092	51	VA	193	WESTMORELAND	05
11093	51	VA	133	NORTHUMBERLAND	05
11094	51	VA	103	LANCASTER	05
11095	51	VA	159	RICHMOND	05
11096	51	VA	057	ESSEX	05
11097	51	VA	119	MIDDLESEX	05
11098	51	VA	115	MATHEWS	05
11099	51	VA	073	GLOUCESTER	05
11100	51	VA	097	KING AND QUEEN	05
11101	51	VA	101	KING WILLIAM	05
11102	51	VA	127	NEW KENT	05
11103	51	VA	095	JAMES CITY	05
11104	51	VA	199	YORK	05
11105	51	VA	650	HAMPTON	05
11106	51	VA	700	NEWPORT NEWS	05
11107	51	VA	036	CHARLES CITY	05

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME	CG DT
11108	51	VA	087	HENRICO (= 087 + 760)	05
11109	51	VA	760	RICHMOND CITY	05
11110	51	VA	041	CHESTERFIELD	05
11111	51	VA	149	PRINCE GEORGE	05
11112	51	VA	181	SURRY	05
11113	51	VA	093	ISLE OF WIGHT	05
11114	51	VA	695	NANSEMOND (= OLD 123)	05
11115	51	VA	710	NORFOLK (=710+550+740)	05
11116	51	VA	550	CHESAPEAKE	05
11117	51	VA	740	PORTSMOUTH	05
11118	51	VA	810	VIRGINIA BEACH	05
11119	37	NC	053	CURRITUCK	05
11120	37	NC	029	CAMDEN	05
11121	37	NC	139	PASQUOTANK	05
11122	37	NC	143	PERQUIMANS	05
11123	37	NC	041	CHOWAN	05
11124	37	NC	073	GATES	05
11125	37	NC	091	HERTFORD	05
11126	37	NC	015	BERTIE	05
11127	37	NC	187	WASHINGTON	05
11128	37	NC	177	TYRRELL	05
11129	37	NC	055	DARE	05
11130	37	NC	095	HYDE	05
11131	37	NC	013	BEAUFORT	05
11132	37	NC	137	PAMLICO	05
11133	37	NC	049	CRAVEN	05
11134	37	NC	031	CARTERET	05
11135	37	NC	133	ONSLOW	05
11136	37	NC	141	PENDER	05
11137	37	NC	129	NEW HANOVER	05
11138	37	NC	019	BRUNSWICK	05
13000				ATL + GULF CSTL + WTRWAY	
13001	45	SC	051	HORRY	07
13002	45	SC	043	GEORGETOWN	07
13003	45	SC	019	CHARLESTON	07
13004	45	SC	029	COLLETON	07
13005	45	SC	013	BEAUFORT	07
13006	45	SC	053	JASPER	07
13007	13	GA	051	CHATHAM	07
13008	13	GA	029	BRYAN	07
13009	13	GA	179	LIBERTY	07
13010	13	GA	191	MCINTOSH	07
13011	13	GA	127	GLYNN	07
13012	13	GA	039	CAMDEN	07
13013	12	FL	089	NASSAU	07
13014	12	FL	031	DUVAL	07
13015	12	FL	109	ST. JOHNS	07
13016	12	FL	035	FLAGLER	07
13017	12	FL	127	VOLUSIA	07
13018	12	FL	009	BREVARD	07
13019	12	FL	061	INDIAN RIVER	07
13020	12	FL	111	ST. LUCIE	07
13021	12	FL	085	MARTIN	07
13022	12	FL	099	PALM BEACH	07
13023	12	FL	011	BROWARD	07

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME	CG DT	
13024	12	FL	025	DADE	07	
13025	12	FL	087	MONROE	07	
13026	12	FL	021	COLLIER	07	
13027	12	FL	071	LEE	07	
13028	12	FL	015	CHARLOTTE	07	
13029	12	FL	115	SARASOTA	07	
13030	12	FL	081	MANATEE	07	
13031	12	FL	057	HILLSBOROUGH	07	
13032	12	FL	103	PINELLAS	07	
13033	12	FL	101	PASCO	07	
13034	12	FL	053	HERNANDO	07	
13035	12	FL	017	CITRUS	07	
13036	12	FL	075	LEVY	07	
13037	12	FL	029	DIXIE	07	
13038	12	FL	123	TAYLOR	07	
13039	12	FL	065	JEFFERSON	07	
13040	12	FL	129	WAKULLA	07	
13041	12	FL	037	FRANKLIN	07	
13042	12	FL	045	GULF	08	
13043	12	FL	005	BAY	08	
13044	12	FL	131	WALTON	08	
13045	12	FL	091	OKALOOSA	08	
13046	12	FL	113	SANTA ROSA	08	
13047	12	FL	033	ESCAMBIA	08	
13048	01	AL	003	BALDWIN	08	
13049	01	AL	097	MOBILE	08	
13050	28	MS	059	JACKSON	08	
13051	28	MS	047	HARRISON	08	
13052	28	MS	045	HANCOOK	08	
13053	22	LA	103	ST. TAMMANY	08	
13054	22	LA	105	TANGIPAHOA	08	
13055	22	LA	063	LIVINGSTON	08	
13056	22	LA	033	EAST BATON ROUGE	08	LM 215 - LM 258
13057	22	LA	121	WEST BATON ROUGE	08	LM 215 - LM 258
13058	22	LA	005	ASCENSION	08	LM 170 - LM 187
13059	22	LA	047	IBERVILLE	08	LM 187 - LM 215
13060	22	LA	093	ST. JAMES	08	LM 148 - LM 170
13061	22	LA	095	ST. JOHN THE BAPTIST	08	LM 133 - LM 148
13062	22	LA	089	ST. CHARLES	08	LM 115 - LM 133
13063	22	LA	051	JEFFERSON	08	LM 95 - LM 115
13064	22	LA	071	ORLEANS	08	LM 91 - LM 104
13065	22	LA	087	ST. BERNARD	08	LM 82 - LM 91
13066	22	LA	075	PLAQUEMINES	08	LM 0 - LM 82
13067	22	LA	057	LAFOURCHE	08	
13068	22	LA	109	TERREBONNE	08	
13069	22	LA	101	ST. MARY	08	
13070	22	LA	045	IBERIA	08	
13071	22	LA	113	VERMILLION	08	
13072	22	LA	023	CAMERON	08	
13073	22	LA	019	CALCASIEU	08	
13074	48	TX	361	ORANGE	08	
13075	48	TX	245	JEFFERSON	08	
13076	48	TX	071	CHAMBERS	08	
13077	48	TX	201	HARRIS	08	
13078	48	TX	167	GALVESTON	08	

T.S.C. CODE	ST CD	ST AB	CO CC	COUNTY NAME	CG DT
13079	48	TX	039	BRAZORIA	08
13080	48	TX	321	MATAGORDA	08
13081	48	TX	239	JACKSON	08
13082	48	TX	057	CALHOUN	08
13083	48	TX	469	VICTORIA	08
13084	48	TX	391	REFUGIO	08
13085	48	TX	007	ARANSAS	08
13086	48	TX	409	SAN PATRICIO	08
13087	48	TX	355	NUECES	08
13088	48	TX	273	KLEBERG	08
13089	48	TX	261	KENEDY	08
13090	48	TX	489	WILLACY	08
13091	48	TX	061	CAMERON	08
15000				PACIFIC COAST + WATERWAY	
15001	06	CA	073	SAN DIEGO	11
15002	06	CA	059	ORANGE	11
15003	06	CA	037	LOS ANGELES	11
15004	06	CA	111	VENTURA	11
15005	06	CA	083	SANTA BARBARA	12
15006	06	CA	079	SAN LUIS OBISPO	12
15007	06	CA	053	MONTEREY	12
15008	06	CA	087	SANTA CRUZ	12
15009	06	CA	081	SAN MATEO	12
15010	06	CA	085	SANTA CLARA	12
15011	06	CA	075	SAN FRANCISCO	12
15012	06	CA	001	ALAMEDA	12
15013	06	CA	013	CONTRA COSTA	12
15014	06	CA	067	SACRAMENTO	12
15015	06	CA	077	SAN JOAQUIN	12
15016	06	CA	095	SOLANO	12
15017	06	CA	055	NAPA	12
15018	06	CA	041	MARIN	12
15019	06	CA	097	SONOMA	12
15020	06	CA	045	MENDOCINO	12
15021	06	CA	023	HUMBOLDT	12
15022	06	CA	015	DEL NORTE	12
15023	41	OR	015	CURRY	13
15024	41	OR	011	COOS	13
15025	41	OR	019	DOUGLAS	13
15026	41	OR	039	LANE	13
15027	41	OR	041	LINCOLN	13
15028	41	OR	057	TILLAMOOK	13
15029	41	OR	007	CLATSOP	13
15030	41	OR	009	COLUMBIA	13
15031	41	OR	051	MULTNOMAH	13
15032	53	WA	015	COWLITZ	13
15033	53	WA	069	WAHKIAKUM	13
15034	53	WA	049	PACIFIC	13
15035	53	WA	027	GRAYS HARBOR	13
15036	53	WA	031	JEFFERSON	13
15037	53	WA	009	CLALLAM	13
15038	53	WA	045	MASON	13
15039	53	WA	035	KITSAP	13
15040	53	WA	067	THURSTON	13
15041	53	WA	053	PIERCE	13

T.S.C. CODE	ST CD	ST AB	CO CC	COUNTY NAME	CG DT	
15042	53	WA	033	KING	13	
15043	53	WA	061	SNOHOMISH	13	
15044	53	WA	057	SKAGIT	13	
15045	53	WA	073	WHATCOM	13	
15046	53	WA	055	SAN JUAN	13	
15047	53	WA	029	ISLAND	13	
17000				ALASKA COAST		
17001	02	AK	190	OUTER KETCHIKAN	17	
17002	02	AK	130	KETCHIKAN	17	
17003	02	AK	200	PRINCE OF WALES	17	
17004	02	AK	280	WRANGELL PETERSBURG	17	
17005	02	AK	220	SITKA	17	
17006	02	AK	030	ANGOON	17	
17007	02	AK	110	JUNEAU	17	
17008	02	AK	100	HAINES	17	
17009	02	AK	230	SKAGWAY-YAKUTAT	17	
17010	02	AK	080	CORDOVA MCCARTHY	17	
17011	02	AK	260	VALDEZ-CHITINA-WHITTIER	17	
17012	02	AK	210	SEWARD	17	
17013	02	AK	020	ANCHORAGE	17	
17014	02	AK	170	MATANUSKA-SUSITNA	17	
17015	02	AK	120	KENAI-COOK-INLET	17	
17016	02	AK	150	KODIAK	17	
17017	02	AK	010	ALEUTIAN ISLANDS	17	
17018	02	AK	070	BRISTOL BAY	17	
17019	02	AK	060	BRISTOL BAY BOROUGH	17	
17020	02	AK	050	BETHEL	17	
17021	02	AK	270	WADE HAMPTON	17	
17022	02	AK	180	NOME	17	
17023	02	AK	140	KOBUK	17	
17024	02	AK	040	BARROW - NORTH SLOPE	17	
17025	02	AK	250	UPPER YUKON	17	
18000				HAWAII COAST		
18001	15	HI	001	HAWAII	14	
18002	15	HI	009	MAUI	14	
18003	15	HI	003	HONOLULU	14	
18004	15	HI	007	KAUAI	14	
30000				INLAND WATERWAY		
31000				LOWER MISSISSIPPI RIVER		
31001	22	LA	125	WEST FELICIANA	08	LM 258 - LM 305
31002	22	LA	077	POINTE COUPEE	08	LM 258 - LM 305
31003	28	MS	157	WILKINSON	08	LM 305 - LM 340
31004	22	LA	029	CONCORDIA	08	LM 305 - LM 380
31005	28	MS	001	ADAMS	08	LM 340 - LM 380
31006	28	MS	063	JEFFERSON	08	LM 380 - LM 390
31007	28	MS	021	CLAIBORNE	08	LM 390 - LM 420
31008	22	LA	107	TENSAS	08	LM 380 - LM 420
31009	22	LA	065	MADISON	08	LM 420 - LM 460
31010	28	MS	149	WARREN	08	LM 420 - LM 430
31011	28	MS	055	ISSAQUENA	08	LM 430 - LM 507
31012	22	LA	035	EAST CARROLL	08	LM 460 - LM 507
31013	05	AR	017	CHICOT	02	LM 507 - LM 550
31014	28	MS	151	WASHINGTON	02	LM 507 - LM 550
31015	28	MS	011	BOLIVAR	02	LM 550 - LM 620
31016	[illegible]	AR	041	DESHA	02	LM 550 - LM 620

T.S.C. CODE	ST CO	ST AB	CO CC	COUNTY NAME	CG DT		
31017	28	MS	027	COAHOMA	02	LM 620 - LM 662	
31018	05	AR	107	PHILLIPS	02	LM 620 - LM 673	
31019	05	AR	077	LEE	02	LM 673 - LM 697	
31020	28	MS	143	TUNICA	02	LM 662 - LM 697	
31021	28	MS	033	DE SOTO	02	LM 697 - LM 715	
31022	05	AR	035	CRITTENDEN	02	LM 697 - LM 760	
31023	47	TN	157	SHELBY	02	LM 715 - LM 755	
31024	47	TN	167	TIPTON	02	LM 755 - LM 773	
31025	47	TN	097	LAUDERDALE	02	LM 773 - LM 820	
31026	05	AR	093	MISSISSIPPI	02	LM 760 - LM 829	
31027	47	TN	045	DYER	02	LM 820 - LM 845	
31028	29	MO	155	PEMISCOT	02	LM 829 - LM 870	
31029	47	TN	095	LAKE	02	LM 845 - LM 905	
31030	21	KY	075	FULTON	02	LM 905 - LM 930	
31031	29	MO	143	NEW MADRID	02	LM 870 - LM 915	
31032	21	KY	105	HICKMAN	02	LM 930 - LM 940	
31033	21	KY	039	CARLISLE	02	LM 940 - LM 950	
31034	29	MO	133	MISSISSIPPI	02	LM 915 - LM 954	UM 0 - UM 26
32000				UPPER MISSISSIPPI RIVER			
32001	29	MO	201	SCOTT	02	UM 26 - UM 48	OH 981 - OH 975
32002	17	IL	003	ALEXANDER	02	UM 48 - UM 55	OH 981 - OH 975
32003	17	IL	181	UNION	02	UM 55 - UM 78	
32004	29	MO	031	CAPE GIRARDEAU	02	UM 48 - UM 75	
32005	29	MO	157	PERRY	02	UM 75 - UM 110	
32006	17	IL	077	JACKSON	02	UM 78 - UM 110	
32007	17	IL	157	RANDOLPH	02	UM 110 - UM 136	
32008	29	MO	193	STE GENEVIEVE	02	UM 110 - UM 139	
32009	29	MO	099	JEFFERSON	02	UM 139 - UM 161	
32010	17	IL	133	MONROE	02	UM 136 - UM 172	
32011	17	IL	163	ST. CLAIR	02	UM 172 - UM 183	
32012	29	MO	189	ST. LOUIS	02	UM 161 - UM 196	MO 0 - MO 49
32013	17	IL	119	MADISON	02	UM 183 - UM 209	
32014	29	MO	183	ST CHARLES	02	UM 196 - UM 237	MO 0 - MO 67
32015	17	IL	083	JERSEY	02	UM 209 - UM 220	IL 0 - IL 18
32016	29	MO	113	LINCOLN	02	UM 237 - UM 258	
32017	17	IL	013	CALHOUN	02	UM 220 - UM 276	IL 0 - IL 39
32018	29	MO	163	PIKE	02	UM 258 - UM 297	
32019	17	IL	149	PIKE	02	UM 272 - UM 312	IL 39 - IL 72
32020	29	MO	173	RALLS	02	UM 297 - UM 306	
32021	29	MO	127	MARION	02	UM 306 - UM 329	
32022	17	IL	001	ADAMS	02	UM 312 - UM 347	
32023	29	MO	111	LEWIS	02	UM 329 - UM 351	
32024	29	MO	045	CLARK	02	UM 351 - UM 361	
32025	17	IL	067	HANCOCK	02	UM 347 - UM 391	
32026	19	IA	111	LEE	02	UM 361 - UM 396	
32027	17	IL	071	HENDERSON	02	UM 391 - UM 426	
32028	19	IA	057	DES MOINES	02	UM 396 - UM 426	
32029	19	IA	115	LOUISA	02	UM 426 - UM 449	
32030	17	IL	131	MERCER	02	UM 426 - UM 449	
32031	17	IL	161	ROCK ISLAND	02	UM 449 - UM 512	
32032	19	IA	139	MUSCATINE	02	UM 449 - UM 470	
32033	19	IA	163	SCOTT	02	UM 470 - UM 507	
32034	17	IL	195	WHITESIDE	02	UM 512 - UM 525	
32035	19	IA	045	CLINTON	02	UM 507 - UM 533	
32036	17	IL	015	CARROLL	02	UM 525 - UM 549	

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME		CG DT		
32037	19	IA	097	JACKSON		02	UM 533 - UM 567	
32038	17	IL	085	JO DAVIESS		02	UM 549 - UM 581	
32039	19	IA	061	DUBUQUE		02	UM 567 - UM 601	
32040	55	WI	043	GRANT		02	UM 581 - UM 631	
32041	19	IA	043	CLAYTON		02	UM 601 - UM 637	
32042	55	WI	023	CRAWFORD		02	UM 631 - UM 668	
32043	19	IA	005	ALLAMAKEE		02	UM 637 - UM 674	
32044	55	WI	123	VERNON		02	UM 668 - UM 691	
32045	27	MN	055	HOUSTON		02	UM 674 - UM 701	
32046	55	WI	063	LA CROSSE		02	UM 691 - UM 713	
32047	27	MN	169	WINONA		02	UM 701 - UM 742	
32048	55	WI	121	TREMPEALEAU		02	UM 713 - UM 722	
32049	27	MN	157	WABASHA		02	UM 742 - UM 773	
32050	55	WI	011	BUFFALO		02	UM 722 - UM 763	
32051	55	WI	091	PEPIN		02	UM 763 - UM 779	
32052	27	MN	049	GOODHUE		02	UM 773 - UM 807	
32053	27	MN	037	DAKOTA		02	UM 807 - UM 836	
32054	55	WI	093	PIERCE		02	UM 779 - UM 811	
32055	27	MN	163	WASHINGTON		02	UM 811 - UM 833	
32056	27	MN	123	RAMSEY		02	UM 833 - UM 850	
32057	27	MN	053	HENNEPIN		02	UM 850 - UM 868	
32058	27	MN	003	ANOKA		02	UM 858 - UM 868	
33000				ILLINOIS RIVER				
33001	17	IL	197	WILL		02	IL 274 - IL 299	
33002	17	IL	063	GRUNDY		02	IL 254 - IL 274	
33003	17	IL	099	LA SALLE		02	IL 220 - IL 254	
33004	17	IL	155	PUTNAM		02	IL 199 - IL 220	
33005	17	IL	011	BUREAU		02	IL 206 - IL 220	
33006	17	IL	123	MARSHALL		02	IL 185 - IL 199	
33007	17	IL	203	WOODFORD		02	IL 168 - IL 182	
33008	17	IL	143	PEORIA		02	IL 140 - IL 185	
33009	17	IL	179	TAZEWELL		02	IL 133 - IL 168	
33010	17	IL	057	FULTON		02	IL 109 - IL 140	
33011	17	IL	125	MASON		02	IL 98 - IL 133	
33012	17	IL	169	SCHUYLER		02	IL 84 - IL 109	
33013	17	IL	017	CASS		02	IL 75 - IL 98	
33014	17	IL	009	BROWN		02	IL 72 - IL 84	
33015	17	IL	137	MORGAN		02	IL 68 - IL 75	
33016	17	IL	171	SCOTT		02	IL 48 - IL 68	
33017	17	IL	061	GREENE		02	IL 18 - IL 48	
34000				OHIO RIVER				
34001	17	IL	153	PULASKI		02	OH 975 - OH 956	
34002	21	KY	007	BALLARD		02	OH 981 - OH 956	
34003	21	KY	145	MCCRACKEN		02	OH 956 - OH 932	TN 0 - TN 8
34004	17	IL	127	MASSAC		02	OH 956 - OH 928	
34005	17	IL	151	POPE		02	OH 928 - OH 897	
34006	21	KY	139	LIVINGSTON	CB 18 - CB 25	02	OH 932 - OH 893	TN 0 - TN 25
34007	21	KY	055	CRITTENDEN	CB 18 - CB 21	02	OH 893 - OH 874	
34008	17	IL	069	HARDIN		02	OH 897 - OH 867	
34009	17	IL	059	GALLATIN		02	OH 867 - OH 848	
34010	21	KY	225	UNION		02	OH 874 - OH 832	
34011	18	IN	129	POSEY		02	OH 848 - OH 816	
34012	18	IN	163	VANDERBURGH		02	OH 816 - OH 780	
34013	21	KY	101	HENDERSON		02	OH 832 - OH 771	GR 0 - GR 41
34014	18	IN	173	WARRICK		02	OH 780 - OH 769	

T.S.C. CODE	ST CD	ST AB	CO CD	COUNTY NAME	CG DT	
34015	21	KY	059	DAVIESS	02	OH 771 - OH 742 GR 19 - GR 35
34016	21	KY	091	HANCOCK	02	OH 742 - OH 712
34017	18	IN	147	SPENCER	02	OH 769 - OH 731
34018	18	IN	123	PERRY	02	OH 731 - OH 681
34019	21	KY	027	BRECKINRIDGE	02	OH 712 - OH 698
34020	21	KY	163	MEADE	02	OH 698 - OH 630*
34021	18	IN	025	CRAWFORD	02	OH 681 - OH 663
34022	18	IN	061	HARRISON	02	OH 663 - OH 617
34023	21	KY	029	BULLITT	02	
34024	21	KY	111	JEFFERSON	02	OH 630 - OH 593
34025	18	IN	043	FLOYD	02	OH 617 - OH 607
34026	18	IN	019	CLARK	02	OH 607 - OH 572
34027	21	KY	185	OLDHAM	02	OH 593 - OH 576
34028	21	KY	223	TRIMBLE	02	OH 576 - OH 555
34029	18	IN	077	JEFFERSON	02	OH 572 - OH 546
34030	21	KY	041	CARROLL	02	OH 555 - OH 535
34031	18	IN	155	SWITZERLAND	02	OH 546 - OH 510
34032	21	KY	077	GALLATIN	02	OH 535 - OH 517
34033	21	KY	015	BOONE	02	OH 517 - OH 477
34034	18	IN	115	OHIO	02	OH 510 - OH 499
34035	18	IN	029	DEARBORN	02	OH 499 - OH 491
34036	39	OH	061	HAMILTON	02	OH 491 - OH 455
34037	21	KY	117	KENTON	02	OH 477 - OH 470
34038	21	KY	037	CAMPBELL	02	OH 470 - OH 444
34039	39	OH	025	CLERMONT	02	OH 455 - OH 430
34040	21	KY	023	BRACKEN (Pendleton)	02	OH 444 - OH 421
34041	39	OH	015	BROWN	02	OH 430 - OH 405
34042	21	KY	161	MASON	02	OH 421 - OH 401
34043	39	OH	001	ADAMS	02	OH 405 - OH 375
34044	21	KY	135	LEWIS	02	OH 401 - OH 357
34045	39	OH	145	SCIOTO	02	OH 375 - OH 335
34046	21	KY	089	GREENUP	02	OH 357 - OH 325
34047	21	KY	019	BOYD	02	OH 325 - OH 317
34048	39	OH	087	LAWRENCE	02	OH 335 - OH 292
34049	54	WV	099	WAYNE	02	OH 317 - OH 312
34050	54	WV	011	CABELL	02	OH 312 - OH 287
34051	54	WV	053	MASON	02	OH 287 - OH 234 KN 0 - KN 19
34052	39	OH	053	GALLIA	02	OH 292 - OH 257
34053	39	OH	105	MEIGS	02	OH 257 - OH 200
34054	54	WV	035	JACKSON	02	OH 234 - OH 206
34055	39	OH	009	ATHENS	02	OH 200 - OH 196
34056	54	WV	107	WOOD	02	OH 206 - OH 165
34057	54	WV	073	PLEASANTS	02	OH 165 - OH 147
34058	39	OH	167	WASHINGTON	02	OH 196 - OH 140
34059	54	WV	095	TYLER	02	OH 147 - OH 133
34060	54	WV	103	WETZEL	02	OH 133 - OH 122
34061	39	OH	111	MONROE	02	OH 140 - OH 111
34062	54	WV	051	MARSHALL	02	OH 122 - OH 93
34063	39	OH	013	BELMONT	02	OH 111 - OH 84
34064	54	WV	069	OHIO	02	OH 93 - OH 82
34065	39	OH	081	JEFFERSON	02	OH 84 - OH 50
34066	54	WV	009	BROOKE	02	OH 82 - OH 65
34067	54	WV	029	HANCOCK	02	OH 65 - OH 40
34068	39	OH	029	COLUMBIANA	02	OH 50 - OH 40
34069	42	PA	007	BEAVER	02	OH 40 - OH 15
34070	42	PA	003	ALLEGHENY MH 0 - MH 35	02	OH 15 - OH 0 AL 0 - AL 30

T.S.C. CODE	ST CD	ST AB	CC CD	COUNTY NAME	CG DT		
35000				CUMBERLAND RIVER			
35001	21	KY	157	MARSHALL	02		TN 8 - TN 44
35002	21	KY	143	LYON	02	CB 21 - CB 55	TN 25 - TN 35
35003	21	KY	221	TRIGG	02	CB 55 - CB 75	TN 35 - TN 49
35004	47	TN	161	STEWART	02	CB 75 - CB 107	TN 49 - TN 74
35005	47	TN	125	MONTGOMERY	02	CB 107 - CB 144	
35006	47	TN	021	CHEATHAM	02	CB 144 - CB 164	
35007	47	TN	037	DAVIDSON	02	CB 164 - CB 222	
36000				TENNESSEE RIVER			
36001	21	KY	035	CALLOWAY	02	TN 44 - TN 63	
36002	47	TN	079	HENRY	02	TN 63 - TN 74	
36003	47	TN	005	BENTON	02	TN 74 - TN 120	
36004	47	TN	083	HOUSTON	02	TN 74 - TN 83	
36005	47	TN	085	HUMPHREYS	02	TN 83 - TN 118	
36006	47	TN	135	PERRY	02	TN 118 - TN 153	
36007	47	TN	039	DECATUR	02	TN 120 - TN 172	
36008	47	TN	181	WAYNE	02	TN 153 - TN 160	
36009	47	TN	071	HARDIN	02	TN 160 - TN 215	
36010	28	MS	141	TISHOMINGO	02	TN 215 - TN 226	
36011	01	AL	077	LAUDERDALE	02	TN 219 - TN 284	
36012	01	AL	033	COLBERT	02	TN 226 - TN 274	
36013	01	AL	079	LAWRENCE	02	TN 274 - TN 296	
36014	01	AL	083	LIMESTONE	02	TN 285 - TN 317	
36015	01	AL	089	MADISON	02	TN 317 - TN 345	
36016	01	AL	103	MORGAN	02	TN 296 - TN 336	
36017	01	AL	095	MARSHALL	02	TN 336 - TN 375	
36018	01	AL	071	JACKSON	02	TN 375 - TN 417	
36019	47	TN	115	MARION	02	TN 417 - TN 452	
36020	47	TN	065	HAMILTON	02	TN 452 - TN 499	
36021	47	TN	121	MEIGS	02	TN 497 - TN 544	HI 0 - HI 9
36022	47	TN	143	RHEA	02	TN 499 - TN 544	
36023	47	TN	145	ROANE	02	TN 544 - TN 578	CL 0 - CL 29
36024	47	TN	105	LOUDON	02	TN 578 - TN 611	CL 21 - CL 28
36025	47	TN	009	BLOUNT	02	TN 607 - TN 635	
36026	47	TN	093	KNOX	02	TN 611 - TN 652	CL 28 - CL 46
37000				ALLEGHENY RIVER			
37001	42	PA	129	WESTMORELAND	02	AL 18 - AL 30	MH 35 - MH 44
37002	42	PA	005	ARMSTRONG	02	AL 30 - AL 75	
38000				MONOGAHELA RIVER			
38001	42	PA	125	WASHINGTON	02	MH 25 - MH 67	
38002	42	PA	051	FAYETTE	02	MH 44 - MH 91	
38003	42	PA	059	GREENE	02	MH 67 - MH 91	
38004	54	WV	061	MONONGALIA	02	MH 91 - MH 118	
38005	54	WV	049	MARION	02	MH 118 - MH 129	
39000				KANAWHA RIVER			
39001	54	WV	079	PUTNAM	02	KN 19 - KN 91	
39002	54	WV	039	KANAWHA	02	KN 44 - KN 85	
50000				GREAT LAKES WTRWAY + RIVS			
51000				LAKE SUPERIOR WATERWAY			
51001	27	MN	031	COOK	09	IL 299 - IL 330	
51002	27	MN	075	LAKE	09		
51003	27	MN	137	ST. LOUIS	09		
51004	27	MN	017	CARLTON	09		
51005	55	WI	031	DOUGLAS	09		
51006	55	WI	007	BAYFIELD	09		

T.S.C. CODE	ST CD	ST AP	CO CD	COUNTY NAME	CG DT
51007	55	WI	003	ASHLANC	09
51008	55	WI	051	IRON	09
51009	26	MI	053	GOGEBIC	09
51010	26	MI	131	ONTONAGON	09
51011	26	MI	061	HOUGHTON	09
51012	26	MI	083	KEWEENAW	09
51013	26	MI	013	BARAGA	09
51014	26	MI	103	MARQUETTE	09
51015	26	MI	003	ALGER	09
51016	26	MI	095	LUCE	09
51017	26	MI	033	CHIPPEWA	09
53000				LAKE MICHIGAN WATERWAY	
53018	26	MI	097	MACKINAC	09
53019	26	MI	153	SCHOOLCRAFT	09
53020	26	MI	041	DELTA	09
53021	26	MI	109	MENOMINEE	09
53022	55	WI	075	MARINETTE	09
53023	55	WI	083	OCONTO	09
53024	55	WI	009	BROWN	09
53025	55	WI	029	DOOR	09
53026	55	WI	061	KEWAUNEE	09
53027	55	WI	071	MANITOWOC	09
53028	55	WI	117	SHEBOYGAN	09
53029	55	WI	089	OZAUKEE	09
53030	55	WI	079	MILWAUKEE	09
53031	55	WI	101	RACINE	09
53032	55	WI	059	KENOSHA	09
53033	17	IL	097	LAKE	09
53034	17	IL	031	COOK	09
53037	18	IN	089	LAKE	09
53038	18	IN	127	PORTER	09
53039	18	IN	091	LA PORTE	09
53040	26	MI	021	BERRIEN	09
53041	26	MI	159	VAN BUREN	09
53042	26	MI	005	ALLEGAN	09
53043	26	MI	139	OTTAWA	09
53044	26	MI	121	MUSKEGON	09
53045	26	MI	127	OCEANA	09
53046	26	MI	105	MASON	09
53047	26	MI	101	MANISTEE	09
53048	26	MI	019	BENZIE	09
53049	26	MI	089	LEELANAU	09
53050	26	MI	055	GRAND TRAVERSE	09
53051	26	MI	009	ANTRIM	09
53052	26	MI	029	CHARLEVOIX	09
53053	26	MI	047	EMMET	09
55000				LAKE HURON WATERWAY	
55054	26	MI	031	CHEBOYGAN	09
55055	26	MI	141	PRESQUE ISLE	09
55056	26	MI	007	ALPENA	09
55057	26	MI	001	ALCONA	09
55058	26	MI	069	IOSCO	09
55059	26	MI	011	ARENAC	09
55060	26	MI	017	BAY	09
55061	26	MI	157	TUSCOLA	09

T.S.C. CODE	ST CD	ST AP	CO CD	COUNTY NAME	CG DT
55062	26	MI	063	HURON	09
55063	26	MI	151	SANILAC	09
55064	26	MI	147	ST. CLAIR	09
57000				LAKE ERIE WATERWAY	
7065	26	MI	099	MACOMB	09
57066	26	MI	163	WAYNE	09
57067	26	MI	115	MONROE	09
57068	39	OH	095	LUCAS	09
57069	39	OH	123	OTTAWA	09
57070	39	OH	143	SANDUSKY	09
57071	39	OH	043	ERIE	09
57072	39	OH	093	LORAIN	09
57073	39	OH	035	CUYAHOGA	09
57074	39	OH	085	LAKE	09
57075	39	OH	007	ASHTABULA	09
57076	42	PA	049	ERIE	09
57077	36	NY	013	CHAUTAUQUA	09
57078	36	NY	029	ERIE	09
58000				LAKE ONTARIO WATERWAY	
58079	36	NY	063	NIAGARA	09
58080	36	NY	073	ORLEANS	09
58081	36	NY	055	MONROE	09
58082	36	NY	117	WAYNE	09
58083	36	NY	011	CAYUGA	09
58084	36	NY	075	OSWEGO	09
58085	36	NY	045	JEFFERSON	09
59000				ST. LAWRENCE RIVER WTRWAY	
59086	36	NY	089	ST. LAWRENCE	09
19000				PUERTO RICO + VIRGIN ISLANDS	
19001	43	PR	001	PUERTO RICO	07
19011	52	VI	001	VIRGIN ISLANDS	07

NOTE : ST/CD - STATE CODE
ST/AP - STATE ABBRIVATION
CO/CD - COUNTY CODE
CG/DT - COAST GUARD DISTRICT

APPENDIX B

SYNOPSES OF INTERVIEWS MADE TO ASSESS CHEMICAL SPILL RESPONSE CAPABILITIES OUTSIDE OF THE U.S. COAST GUARD

1. RESPONSE CAPABILITIES OF GOVERNMENTS AND THEIR AGENCIES

1.1 FEDERAL GOVERNMENT

1.1.1 Environmental Protection Agency

The Environmental Protection Agency (EPA) has the primary responsibility to protect the land areas of the United States, except for those designated areas of Coast Guard responsibility, from pollution caused by the spill of hazardous materials. The EPA provides the On-Scene Coordinator (OSC) for its areas of jurisdiction.

The EPA maintains local emergency response teams ERT. In accordance with the National Contingency Plan these teams provide information, expert consultation, and general support to the OSC. They are not equipped, however, for actual removal action.

For example, the Boston Regional Office has an eight-man team on 24-hour standby. Each man has a self-contained breathing system, a full-face gas mask, a five-minute escape pack, a face shield, and disposable coveralls, gloves, and boots. The team has a complete kit of hand tools and equipment and full complement of detection identification meters (two of each type); H-nu organic vapor detector, oxygen sampler, explosimeter, organic vapor detector tube sampler, continuous oxygen monitor, and pH meter. They can borrow two portable gas chromatographs. Thus, the EPA does have a good investigative response capability but must bring in contractor assistance for containment, off-loading, plugging, removal, and cleanup.

1.1.2 Department of Defense

The Department of Defense (DOD) has a limited hazmat spill response capability. In the event of a spill involving DOD, the Coast Guard or EPA is notified, and DOD assists the OSC by providing any available equipment for either initial response or long-term cleanup. However, DOD relies on contractors for most of its response capability. Specific capabilities within DOD are given in the following sections.

1.1.2.1 Air Force - The Air Force has limited use for or contact with hazardous materials. It relies on contractors for response to spills which occur during transportation of hazardous materials. However, Air Force bases do have special facilities and capabilities which are potentially useful to the Coast Guard, and which can be activated through the DOD contracts listed in the various Contingency Plans. These capabilities would automatically respond to on-base spills or incidents.

All Air Force bases have fire departments which are equipped with fire proximity suits and self-contained breathing apparatus (air packs). For example, Pease AFB in Portsmouth, New Hampshire, is a large base which has 70 proximity suits and 33 air packs, while Hanscom AFB in Bedford, Massachusetts, is a small base which has 20 suits and 20 air packs. In addition, these bases have Disaster Preparedness Teams equipped to deal with non-fire disasters, primarily nuclear/bacteriological/chemical (NBC) events. The teams are equipped with the M-3 Impermeable Suit and the M-9 gas mask made of butyl rubber-coated cloth; this combination provides total encapsulation for the wearer. If the gas mask does not provide protection against the encountered gases, the suit also can be used with an air pack. The Pease Team has 6 suits and 30 gas masks and borrows air packs from the fire department. The Hanscom Team has 20 suits, 20+ gas masks, and 4 air packs. The teams have equipment for measuring radioactivity levels and field-type equipment for identifying chemical warfare agents, but do not have any chemical meters. They also have sophisticated communication equipment.

In addition, some bases also have units equipped with encapsulating suits used for handling exotic rocket fuels. The recent Titan missile mishap in Arkansas pointed out the use of these suits; the chemicals involved were hydrazine and nitrogen tetroxide.

1.1.2.2 Army - The Army Technical Escort Center is responsible for transportation of chemicals and related materials, and has a limited initial spill response capability. Depending on the material spilled, the Army may use contractors for follow-on containment and cleanup. Response capabilities exist at all Army bases; decontamination facilities exist throughout the Army. A typical complement is 100 M-3 suits and a much larger number of M-9 gas masks. In addition to the typical 30-man decontamination team, other units such as the Military Police also have gas masks, so the total number of potentially available masks is large.

Other response capabilities also exist at Army bases. The fire department at Fort Devens, Massachusetts, has 15 fire approach suits and 25 air packs in addition to their regular nomex turnout (rain type) suits. The Fire Chief has also been designated the base OSC by the Environmental Control Office for both oil and chemical spills, and the Department has a small supply of containment boom for oil. Chemical response capability is limited as the base uses few hazardous chemicals. Fort Devens relies extensively on contractors for both initial response and cleanup.

Fort Devens also has an Explosive Ordnance Disposal (EOD) Team equipped with fullface protective masks, M-20 self-contained breathing apparatus, and M-3 protective clothing with acid-resistant aprons. A typical team consists of five men.

1.1.2.3 Navy - Like the other Armed Services, the Navy relies primarily on contractors for response to both chemical and oil spills. The Operations Department, Supervisor of Salvage, has overall responsibility. Some equipment, primarily for oil spills, is stored at central locations at Cheatham Annex, Virginia, and Stockton, California.

Navy bases all have some response capability. For example, the Portsmouth Naval Shipyard in Kittery, Maine, has a well-equipped Fire Department which has three fire entry suits and 26 self-contained breathing sets. In addition, the Material Division is responsible for all oil and chemical pollution control. The Division has six acid suits with hoods, two air packs and four respirators, plus gloves and goggles.

1.1.2.4 Research and Development - While its hazmat spill response capability is limited, DOD does support activities which are similar to, or may impact, hazmat response capabilities of other groups. Some examples are cited here, although this listing is far from complete.

The U.S. Army Laboratory, Natick, Massachusetts, is responsible for developing personnel protective equipment to counter NBC warfare. The hostile biological and chemical agents are encountered as liquid drops, sprays, aerosols, and gases, and act both through respiratory and skin absorption. Thus, encapsulating suits with breathing apparatus are needed. Since an NBC attack would likely be accompanied by attacks with other weapons, the personnel protection equipment must provide protection for long periods of time and must permit the wearer to perform his usual military duties with minimum hindrance. Accordingly, the results of these equipment developments have direct application for hazmat protective equipment.

The Air Force and Navy are concerned with the development of fire suits to permit rescue and fire fighting at aircraft crashes. The Federal Aviation Administration is also involved. Fire suit improvements also have direct application to hazmat protective clothing.

The Air Force (and National Aeronautics and Space Administration) have developed suits for the protection of handlers of rocket fuels such as hydrazine, nitrogen tetroxide and red fuming nitric acid. These suits are directly useable as acid suits for hazmat spill responses.

Much of the information on NBC protective systems, and some of the information on fire and fuel handler suits, carries a military classification.

Therefore, beyond establishing that these development efforts exist, little information could be obtained.

1.1.3 Department of Energy

The Department of Energy (DOE) has both regional and national response teams for response to spills of radiological materials. While these teams normally would respond only to radiological accidents, they do have personnel protection equipment and communication equipment which has direct application to hazmat spill response.

1.2 STATE GOVERNMENTS

State government agencies concerned with hazmat spill response are usually either Environmental Protection Agencies or Water Resources Agencies, who are responsible for preventing contamination of lakes, streams, and waterways. These agencies dispatch inspectors to spill sites, who may act as OSCs to coordinate containment and cleanup efforts. Most contacted states maintain a limited inventory of supplies and equipment, but this capability is intended only for initial response use. Subsequent efforts are transferred either to the spiller or to a cleanup contractor.

Maine, Pennsylvania and Virginia have no protective clothing except rain gear. Ohio has nine ammonia suits with self-contained breathing apparatus. Maryland has five sets of fire-fighting type rubberized clothing with breathing apparatus, and two acid suits. None have asbestos fire suits.

The field inspectors or response teams have field meters. Maine teams have pH meters, explosimeters and gas samplers. Pennsylvania has some pH meters and explosimeters. Ohio and Virginia field inspectors have these meters, plus a water testing capability. Maryland inspectors have pH meters, and 10 equipment trailers have a pump and explosimeter. Ohio has a portable gas chromatograph.

Maine and Pennsylvania rely on police radio networks for communication. The other three states have their own radios and networks for spill response.

1.3 INDEPENDENT AUTHORITIES AND COMMISSIONS

Many regional governmental activities are carried out by independent authorities and commissions, especially in the transportation field. Port Authorities were contacted for these ports: Boston, New Orleans, Los Angeles, Seattle, and Norfolk.

While the capabilities of these port authorities varied, all of them rely on contractors for containment, plugging and/or off-loading the damaged containers, and for follow-on monitoring and cleanup. They also all rely on the Coast Guard, EPA, or CHEMTREC (Chemical Transportation Emergency Center) for material identification.

Seattle and Norfolk have no response capability and rely totally on contractors and/or other government agencies. Los Angeles, New Orleans, and Boston have fire fighting and communication capability. New Orleans and Boston have fire suits with self-contained breathing apparatus. None have acid suits or other chemical response capability.

The Boston Metropolitan District Commission provides police service in the Boston Harbor area, but does not otherwise provide direct assistance in a spill response.

1.4 CITIES

Since detection of and first response to a hazmat spill is usually made by city police and fire departments, these departments were contacted to obtain their method and capability for initial response.

1.4.1 City Police Departments

Police are often the first public officials to arrive at a spill site, either because they respond rapidly to notification of a spill or because they may detect the spill in the course of their patrol activities. Except for an extensive communication network, the police have no response capability. They may assist in initial response activity by acting as a coordinating body to

facilitate emergency response team operations, by evacuating surrounding areas if necessary, and by providing transportation for cleanup personnel and equipment to the spill site.

Police rely on the Coast Guard for hazmat identification. They do have the Chemical Hazard Response Information System (CHRIS) Manual, and lists and procedures issued by the Coast Guard and by CHEMTREC. Some departments have field meters.

1.4.2 City Fire Departments

Fire departments respond to a spill only when requested. They do not patrol their areas, and thus do not detect spills. The fire departments' involvement in a hazmat spill is limited to control of fire. These departments have the primary foam-delivery capability by fire boats and fire trucks. Their on-vehicle foam supply is supported by centralized department supplies and by ready access to manufacturers' stocks, so their foam delivery capability is almost unlimited. In some ports, Coast Guard and Port Authority crews also have a foaming capability.

Fire departments do not have any plugging or off-loading equipment. They rely on the Coast Guard and CHEMTREC for material identification. They also have the CHRIS Manual and the Hazmat Classification Book. They have field meters associated with their fire-fighting mission, such as explosimeters, carbon monoxide testers, oxygen samplers, etc.

The departments usually have fire suits. Philadelphia has three special chemical units equipped with asbestos fire suits with self-contained breathing apparatus. Both New York and Philadelphia also use standard protective clothing, with gas masks, for fire approach and entry.

Most fire departments have extensive communication networks, and can establish working control of a spill area pending arrival of police.

2. RESPONSE CAPABILITIES OF COMMERCIAL CLEAN-UP CONTRACTORS

Commercial clean-up contractors rely upon a diversified in-house staff including chemical engineers, marine biologists, hydrologists, logistics support personnel, and operations managers. National contractors such as Western Environmental Services based in Seattle, Washington, maintain strategically located spill response trailers in various client locations. For example, Western Environmental Services provides response for thirteen major western railroads and numerous trucking firms with 24 response trailers along rights-of-way. Each trailer contains at least the following items:

- 4 Eastwind chemical suits
- 4 MSA air packs, each with 2 spare bottles and an air compressor for tank re-charging
- 6 one-piece butyl rubber suits with attached hoods, neoprene boots and gloves
- 4 Scott baseline respirators with Egress system and 800 feet of umbilical baseline
- 8 full-faced MSA respirators with various cartridges
- 8 half-faced MSA respirators
- 4 gas masks utilizing ambient air
- 1 each, hydrocarbon and oxygen measuring units
- 1 Bendix Gas-Tech with tubes
- 1 explosion-proof, teflon lined, electric chemical transfer pump
- 2 explosion-proof air driven chemical transfer pumps
- 2 each 3-inch diaphragm pumps; 1 stainless, 1 mild steel, both are teflon lined
- 15,000 gallon bladder tank

At the present time, however, few contractors operate spill response trailers or vans such as this. Companies with multiple equipment locations may augment on-scene capabilities by enlisting the aid of the closest ancilliary field offices. Smaller contractors may opt to obtain specific equipment from a competitor.

Transportation of equipment to the site area may be accomplished by utilizing one or a combination of several means including: 1) land transport by truck or van; 2) water transport by boat or barge; or 3) cargo airlift. The latter mode is utilized by Marine Pollution Control of Detroit in the event of a major spill. Their "response kit" consists of acid, disposable, and rubber suits, external and internal breathing apparatus, respirators, vacuum tank trucks, pumps, and drums. All of this equipment is airlifted on a Boeing 747 to the site area.

Contractors generally do not maintain substantial equipment inventories in the following areas:

- Fire Entry and Proximity Suits - equipment is maintained primarily by chemical manufacturers and large city fire departments.
- Plugging and Repair Capabilities - contractors generally perform these functions by subcontracting this work to an ocean salvage company or on land, a chemical shipper producer. Crowley Environmental Services of Seattle, OH Materials of Findlay, Ohio, and Ocean Salvage Corporation of New York do, however, maintain pre-packaged plugging kits containing items such as bentonite, plugs, gasket material, and straps.
- Foam Systems - none of the contractors contacted maintain foam delivery systems or their equivalent.

Several contractors, such as OH Materials, operate mobile laboratories for analytical testing. These self-contained laboratories are capable of being placed anywhere on a site and can run samples utilizing a mass spectrometer in one hour or less to identify chemical components and their respective concentrations. If the sample is beyond the capability of the mobile laboratory it can be analyzed at the company's fixed laboratory in Findlay.

Field testing units such as pH meters, oxygen and multiple gas meters are maintained adequately by most contractors to monitor cleanup efforts. More exotic field testing equipment includes fluorescence, specification, flame iohization, and electron capture techniques, among others. Many smaller, local contractors depend upon independent testing laboratories for thorough and objective chemical analysis.

Off-loading and transfer equipment such as vacuum and tank trucks are maintained on a limited basis by controctors. A typical contractor capability consists of one or two mild steel vacuum trucks and tank trucks (DOT class 316, 317, and 318). If the spilled product requires the use of a teflon, rubber, or plastic lined vacuum or tank truck for chemical transfer, the task is subcontracted to a trucking firm which operates this equipment. The firm must also be licensed to engage in interstate transport of hazardous materials.

Communications equipment maintained and operated by most contractors consists of C.B. radio, UHF, VHF, beepers, walkie-talkies and telephone communications. Coastal Services of Linden, New Jersey, among others, operates a command van to coordinate communications between site personnel, company headquarters, and a "patch" into municipal, state, or Federal communications networks. Communications equipment such as this serves to coordinate any clean-up effort where: a) control mechanisms are contingent upon direction from the OSC, b) numerous agencies in both the public and private sector must coordinate their efforts efficiently, and c) the spill occupies an area too large for direct voice communication.

3. RESPONSE CAPABILITIES OF PRIVATE SPILL CONTROL ORGANIZATIONS

3.1 TRADE ASSOCIATIONS - INFORMATION SOURCES

CHEMTREC, the Chemical Transportation Emergency Center, is a private sector organization of the Chemical Manufacturers Association. It has established a 24 hour, toll free, emergency number to provide technical and procedural assistance in a major spill emergency. CHEMTREC operates in two stages. First, upon receipt of information regarding the name of the spilled chemical, it provides immediate information concerning the nature of the material and initial procedural steps to contain the product. Second, CHEMTREC contacts the shipper and/or producer of the product and alerts them of the incident, risk, and pertinent circumstances. More detailed information is then obtained and relayed through the CHEMTREC coordinator to the OSC. The shipper or producer may opt to send a response team to the scene at this point.

The second stage of CHEMTREC's duties becomes more difficult if either the shipper is unknown or the material is unidentified. In this instance, CHEMTREC may rely upon other information sources such as the Coast Guard National Response Center to identify the shipper/carrier or the Association of American Railroads' commodities movement/tracking system.

CHEMTREC provides no physical assistance in a spill incident, but serves as the vital communication point for the entire emergency response system of the private sector. Its capabilities have been recognized by the DOT as well; working together, the capabilities of both systems are enhanced.

The Chlorine Institute of New York (CHLOREP) is a private consortium of chlorine and compressed gas manufacturers and shippers; it has established 32 designated response zones in the U.S. In the event of a chlorine or compressed gas discharge, CHLOREP's emergency response coordinator receives a notification of the incident from CHEMTREC. The coordinator then dispatches one of 64 U.S.-based response teams to the incident site. The location of these teams is concentrated in areas where the greatest number of manufacturing plants is situated. For example, the Louisiana Panhandle area contains the greatest proportion of chlorine producers in the Nation. Hence this area displays a high correlation of response teams relative to other areas of the Nation.

CHLOREP's emergency response teams are staffed with 12 personnel per team which provide 24-hour coverage. The staffing objective is to provide three personnel per six-hour shift. CHLOREP has also designed and distributed 6,500 chlorine emergency kits to industrial and water treatment plants throughout the U.S. Kits contain various plugging and repair supplies including gasket material, strapping, bentonite clay sealant, heavy plastic tarpulins, and plugs.

Each response team is equipped with at least one kit and enough self-contained breathing apparatus, spare tanks, and respirators to supply each man for an indefinite period of time. CHLOREP response teams arrive at the scene in an average time of 20 minutes, depending upon location and accessibility.

Similarly, CHEMTREC serves as the communication link for at least three other mutual aid programs dedicated to coordinated response for specific products. The National Agricultural Chemicals Association (NACA) has a Pesticide Safety Team network of some 40 emergency teams distributed throughout the country. Mutual assistance programs for other products include vinyl chloride and hydrogen cyanide.

The Association of American Railroads (AAR) tracks the movement of shipments of hazardous chemicals as they move through the railroad network. Each shipment is accompanied by documents which identify the chemical, the shipper, and the recipient; these documents are the primary means of identifying the material in the event of a spill. However, the AAR tracking system serves as a backup for identifying the chemical and the shipper and receiver. The AAR has no equipment of its own, but member railroads may have equipment as discussed below.

The Spill Control Association of America is the trade association for organizations concerned with spill response. Membership includes cleanup contractors, cleanup equipment manufacturers, oil and chemical companies, cleanup training schools, and state EPA offices. The Spill Control Association performed the usual trade association functions. In addition, it provides training seminars and courses, coordinates radio communication networks, and maintains an extensive reference library. It does not own any equipment, but does provide information services.

3.2 CHEMICAL MANUFACTURERS

Most chemical manufacturers have spill response equipment and trained people located at each manufacturing site. The types and quantities of this equipment are tailored to the specific intermediate and final chemical products and to the quantities involved.

Major chemical manufacturers have many plants throughout the Nation. They maintain emergency response teams at strategic plant locations such that rapid initial response is possible.

Manufacturers response teams have been developed to offer initial emergency spill control assistance in the event that a company product is involved in an accidental release. The manufacturer of that product is most familiar with its chemical properties. In addition, manufacturers are now formulating mutual aid agreements to exchange emergency support teams and equipment in the event of a spill outside a given company's region.

The chemical manufacturers' teams are usually not the first to arrive at the spill site. Further, the manufacturers typically limit their function to initial response. They do not engage in longer term containment and cleanup; these functions are turned over to contractors.

For example, Dow Chemical Corporation has over 50 plants manufacturing hazardous materials in the United States. Four major divisions are located in Midland, Michigan; Plaquemine, Louisianna; Freeport, Texas; and Pittsburgh, California. The remaining 46 locations are classified as "satellite plants." Each plant is equipped with a fire department on the premises. Further, Dow has 22 sales offices throughout the Nation which each maintain at least one self-contained breathing unit and have a Sales Officer able to provide advice and request company assistance.

Each plant has developed an emergency response system which is activated through the Emergency Response Coordinator. The Coordinator's legal responsibility is merely advisory but he may and often does provide technical and equipment assistance when needed. Each major division is home base for an emergency response trailer. The contents of each trailer consist of at least the following equipment and supplies dedicated to hazmat emergencies:

- o Personal protective clothing including two Acid King or Eastwind acid suits and three heavy vinyl suits for corrosives
- o Self-contained breathing apparatus consisting of five Scott air-packs (45 minute) and spare cylinders
- o Two each portable pH, oxygen, and explosion meters
- o Two stainless steel, explosion-proof chemical transfer pumps

- Various pipe, hose, and fittings
- Gloves, face shields, boots, and respirators
- One portable gas chromatograph
- One portable infra-red spectrophotometer

The trailer may either be driven to a spill site or containerized and airlifted to the scene.

The Dow plant at Freeport, Texas is representative of equipment which is not specifically dedicated for hazmat but may be utilized in an emergency. Personnel protection equipment consists of 12 vinyl rubber acid suits and two all-purpose heavy duty chemical suits, plus over 1,000 Scott airpacks in the plant. The Fire Department's resources consist of 12 fire trucks with cascade foam delivery systems and one specially modified jet aircraft engine capable of delivering 3,000 gallons of foam per minute to a range of 200 yards. The Department also maintains at least 10 Scott air packs and 20 standard rubber suits. Overpack and recovery drums manufactured by Clearing Container Corporation of Chicago are stored in 19 supply warehouses across the Nation in 5, 55, and 85 gallon sizes. Each warehouse has an inventory of between three and 100 drums depending upon past experience of spills in their respective region(s).

Shell Chemical Corporation also maintains and operates substantial equipment dedicated to emergency response. Shell Chemical maintains a total of 36 airpacks, 22 of which are Scott, 12 MSA, two Survivor units and one explosimeter at each of 22 locations. In addition, 322 overpack drums are presently maintained at strategic locations throughout the country. Portable analytical laboratory equipment consists of a small gas chromatograph (Base Line Industries) coupled with nine Bellar and Lichtenberg volatile organics analyzers. This equipment is maintained in Houston, Texas and is suitable for transportation in the company Falcon jet.

Equipment is also available for chemical response through the Shell Oil Marketing Distribution organization. Through this division, 9 response trailers are located in various Eastern company locations; 15 Southern, 13 Midwestern, 4 Southwestern, and 17 Northwestern. This equipment is primarily

for handling truck spills of gasoline or other hydrocarbons, but may have wider applications. Trailers contain a number of explosimeters and air packs, as well as sorbent material and containment boom.

Hooker Chemical Corporation has adopted a unique approach to respond to chemical emergency indicents. They have developed standard emergency equipment kits as follows:

- Kit #1 - Personal Safety Equipment includes one each of the following: full face MSA respirator, MSA cannister, disposable dust mask, Homer coveralls, face shield, rain suit, gloves, and boots.
- Kit #2 - Tool Kit & Miscellaneous Equipment
- Kit #3 - Self-Contained Breathing Apparatus consists of one 30-minute Scott air pack and spare cylinder.
- Kit #4 - Acid Suit consists of one Eastwind acid suit.
- Kit #5 - Specialty Kits Equipment may contain any or all of the following: explosion meter, oxygen meter, vapor acid suit, phosphorous suit, etc.

A number of kits by type are distributed among each of 22 Hooker plants in the United States. Distribution of kits is based upon historical spill incidents and, in the case of specialty kits (#5), the plant's major products. For example, the Jeffersonville, Indiana plant is a major phosphorous production unit. It maintains the following emergency kit inventory: six each-Kit #1, one each-Kit #2, three each-Kit #3, three each-Kit #4, and three each of Kit #5 which contains a total of three phosphorous suits.

Mobay Chemical Corporation is another example of a manufacturer which has anticipated a need for coordinated response to chemical emergencies with trained personnel and equipment. They have developed an emergency response program to handle their own chemicals by assembling seven response teams in Union, New Jersey; New Martinsville, West Virginia; Pittsburgh, Pennsylvania; Busny Park, South Carolina. Response teams normally consist of two to three members at each producing facility.

Each team is equipped with the following dedicated response equipment:

- o Protective clothing - two acid suits, two rubber slicker suits and two rubber coveralls and boots
- o Self-contained breathing apparatus - minimum of two air packs
- o Portable field testing equipment - minimum of one explosion meter, oxygen meter, and pH meter
- o Vacuum and Tank Trucks - none, utilize local common carrier
- o Chemical transfer pump - New Martinsville has the only portable (50 GPM) plastic lined pump
- o Overpack drums - each facility has a minimum of 10
- o Analytical laboratory equipment - no portable units, utilize plant equipment when necessary

Those chemical manufacturers which have not been discussed herein but have assembled emergency response teams and equipment include Stauffer Chemical Corporation, Dupont Chemical, Amoco Oil and Chemical, Monsanto Chemical, Pittsburgh Plate Glass, and Goodyear Tire and Rubber Corporation. This list combined with previously outlined manufacturers is representative of the "emergency response team state-of-the-art" in the United States but is by no means comprehensive.

3.3 RAILROADS

Five railroad companies were contacted to determine the hazardous material response capability of each. These were the Southern Railway System, Consolidated Rail Corporation, Norfolk and Western Railroad, the Chessie System, and the Boston and Maine Railroad. Technical expertise as well as dedicated emergency response equipment for potential hazardous material spills varies substantially from railroad to railroad. Railroad size, financial status and percent of revenue derived from shipping hazardous materials are among the significant variables which determine spill response capability. Although spill response is a major railroad concern, assuring that the right-of-way is clear of obstructions which may hinder passage of revenue shipments is the first priority. Moreover, most on-scene employees lack

specific training to handle hazardous material emergencies. Generally, if a spill presents a threat to the health of personnel, they are instructed to evacuate the area immediately.

If a freight car is found to be leaking hazmat by a line inspector, the incident is reported to the local dispatcher or trainmaster utilizing the locomotive's radio. The dispatcher must then take steps to isolate the car and identify its contents. The AAR's Standard Transportation Commodity Code (STCC) "49" designates all hazardous materials and their positions in the train's consist. A computer-generated printout of this information is carried by trainmen to expedite chemical identification. Procedures and actions to be taken are followed utilizing the AAR's "Transportation Emergency Guide." The dispatcher than notifies the safety department which in turn notifies government officials, CHEMTREC, and the consignee or shipper. The situation is then re-examined and a decision is made as to whether a "go-team" response is warranted at the incident scene. Spill type, quantity, risk factor, and in-house resources bear on the determination of whether clean-up contractors will be called to the scene.

If a railroad maintains equipment for control and containment, it is usually located in or around classification yards and engine terminals. Both the Chessie System and Norfolk and Western Railroad maintain equipment along rivers which traverse their trackage. Southern's hazmat storage areas are in Atlanta, Birmingham, Greensboro, and Chattanooga.

As a general rule, railroads do not own chemical or thermal protective clothing. The Boston and Maine Railroad and Conrail maintain rainsuits for inclement weather. Chessie System outfits its superintendents with rubber suits, goggles, boots, and self-contained breathing apparatus. Norfolk and Western maintains a supply of respirators and self-contained breathing apparatus at various locations. Southern Railway operates three emergency storage trailers which contain one combustible gas meter, a minimum of 6-12 vinyl rainsuits, and two acid suits with hoods, gloves, boots, and self-contained breathing apparatus. These trailers are towed to the incident scene by one of six vehicles operated by the safety department. Spill crews arrive at the scene by rail, automobile, or air.

All the railroads contacted, with the exception of the Boston and Maine, maintain limited boom as follows: Conrail maintains containment booms at various locations; Chessie has 300 feet of sorbent boom in Russell, Kentucky; 200 feet in Grand Rapids, Michigan and a minimum of 200 feet in Huntington, West Virginia; Clifton Forge, Virginia; and Cincinnati, Ohio yards. Chessie also maintains 400 feet of sorbent blanket and 80 feet of boom in each of 49 locations throughout Ohio, West Virginia, Virginia, Maryland, Illinois, Pennsylvania, Michigan, Kentucky, and Indianna. Norfolk and Western operates three emergency spill trailers in Decatur, Illinois; Bellevue, Ohio, and Princeton, New Jersey. Each trailer contains 150 feet of floating boom, disposable solvent boom, a small Manatary head oil skimmer, and a 1,000 gallon collapsible tank. Southern Railway stores 300 feet of sorbent boom in Chattanooga.

Off-loading of spilled product is a contractor function, however, a diesel locomotive can pump material or generate electricity for a cleanup effort in isolated areas. Additionally, the Boston and Maine maintains one submersible hydraulic pump in Somerville and East Deerfield, Massachusetts; and Mechanicsville, New York. Southern Railway operates an unspecified number of portable gasoline and annhydrous ammonia pumps.

Railroads generally rely upon independent testing laboratories for field and analytical testing, identification, and monitoring of contaminants. However, most contacted railroads maintain a limited capability to perform analytical testing. The Boston and Maine has one explosimeter; Chessie System has eight pH meters each in Huntington and Russell, as well as an emission spectrophotometer in Huntington. Conrail's Cleveland facility employs chemists to work in an in-house analytical laboratory with a mass spectrometer and gas chromatograph. Norfolk and Western's Roanoke, Virginia laboratory has a mass spectrometer and atomic absorption spectrophotometer. Each of Southern Railway Systems' field inspectors is equipped with a universal sampler and combustible gas meter.

APPENDIX C

PERSONNEL PROTECTION GEAR REQUIREMENTS FOR HAZARDOUS CHEMICAL SPILL RESPONSE

I. Litant

Office of Energy and Environment
Transportation Systems Center

This Appendix summarizes the work leading to the quantification of the personnel protective equipment required for response to various types and sizes of hazardous chemical spills that have occurred in the United States in 1973-1979.

1. INTRODUCTION

A large amount of work has been done over the past years by government and private agencies in assembling data on the types and frequency of occurrence of spills of hazardous materials, as well as categorizing response gear for use against each type of spilled material. (References 1 through 11.) In most spills, the hazardous materials were capable of being identified as individual chemicals. In some cases, however, the spilled material was a mixture, sometimes complex, containing one or more hazardous chemicals.

A spilled hazardous material requires that some action be taken to prevent an adverse effect upon the local population and the environment. A hazardous spill response team, if provided with correct information concerning the type and quantity of the material, should be prepared to cope with the situation without delay.

Historic hazardous materials spills have been recorded by the Materials Transportation Bureau (MTB) and the Coast Guard Pollution Incident Reporting System (PIRS). These data have been summarized by type, frequency, and wherever possible, by quantity of spill. (See Reference 12.) Many of the spills were identified only vaguely, and required judgment to determine how to categorize them.

Various coding systems have been devised to group the materials into some sort of order that would be useful in determining how to cope with the spills. The CHRIS Code is one example of the several methods to do this.

Other codes have been devised which provide the reader with most of the physical and chemical properties into a useful, but cumbersome system. Yet another code groups the chemicals by chemical families.

The various codes were surveyed to determine which might be most useful overall. The CHRIS code, although useful, does not present sufficient information to permit the selection of specific response gear. The code that provides such a large amount of physical and chemical data in encoded form, as already mentioned, is too cumbersome when one considers the large number of chemicals that must be so characterized.

One method of grouping calls for combining chemicals in their chemical families, i.e., alcohols, ketones, esters, hydrocarbons, etc. Although generally, members of the same chemical family react chemically in a similar manner, the physical properties can vary significantly as one increases the number of carbon atoms in a homologous series. The difference between a C1 and C6 in the same homologous series is sufficient to require very different response.

For the purposes of the current work, the progression to the goal took the following steps.

1. Bridging and classification of hazardous materials spills.

2. Response gear required for different hazardous materials.

3. Elastomer compatibility with different hazardous materials.

4. Quantities of equipment as a function of spill size and material.

Each of these steps is described in this report.

1. Bridging and Classification of Hazardous Materials Spills

A survey was made of the lists of hazardous spills compiled by both the Materials Transportation Board (MTB) and the Coast Guard Pollution Incident Reporting System (PIRS). Spill incidents, down to a rate of one spill in a seven-year period (1973-1979) were included. The objective was to relate each of the indicated spills to a CHRIS-coded material, and eventually to assign to the particular material such response gear as would be required by Coast Guard personnel to cope with a spill of that material.

There was little problem in "bridging" between the MTB and PIRS lists and CHRIS where the chemical compound or material was specific in each. However, bridging became difficult where one MTB or PIRT entry consisted of groups such as "Zinc Compounds" or "Cyanide Compounds." Even more difficult to classify were "Corrosive Liquid N.O.S.", "Flammable Liquids", or "Comp. Rust Preventer or Remover". In the case of grouped compounds of the same element, the entry was treated as would be the most hazardous commonly used compound of that group. In the second type, "Corrosive Liquids", etc. the literature was consulted, where possible, to get an idea of the chemicals that might be used in such mixtures. A judgment was then made as to its classification.

Altogether, 156 MTB and 166 PIRS materials were classified. As might be expected, there was some duplication between the lists. However, the cases in which no direct correspondence could be established between MTB, PIRS and CHRIS chemicals represented a majority of the cases of historic spills. (Reference 13.) Accordingly, attempts employ a single chemical list were abandoned, and equipment assignments were made on the PIRS and MTB chemical lists separately.

2. Response Gear Required for Different Hazardous Materials

The second task in this project was to list the types of personnel protective gear that would be required by a person responding to a spill of each of the different hazardous materials. The results are shown in Appendix C-1. In preparing this list, several considerations to be made before defining the level of protection categories. W.M. Hammer, et al (Reference 11) propose the following requirements in the selection of equipment:

a. Physical motion should be as natural and unimpeded as possible.

b. The equipment should be able to function throughout the period of time that an individual expects to be within the boundaries of the hazard.

c. The equipment should be tough and reusable, if it can be determined.

d. Normal decontamination methods should be simple, rapid and non-destructive.

e. Personnel utilizing the equipment should feel reasonably comfortable and confident of their own safety.

A spill of hazardous chemicals involves the consideration of many variables. This makes it mandatory that the responders receive many details of the incident before deciding how best to respond. They should know, among other things, the name and chemical and physical characteristics of the spilled material, the size of the container, and the environmental conditions. Each of these has a determining effect on the type and manner of response gear required.

In order to provide a basis upon which to selected personnel response gear, it was necessary to establish certain ground rules. These rules and the rationale for them are as follows:

a. The selection of personnel protective gear in this Appendix is based upon there being no fire at the scene of the spill. Many of the hazardous materials are flammable. Furthermore, combustion could create highly toxic products. For this Appendix, it is assumed that there will be present, in addition to the selected gear, other body protection suitable for use in a fire situation. Another fall-back position should be the presence of self-contained breathing apparatus for possible use in the event of fire.

   An additional problem associated with the occurrence of fire at a hazardous spill is the likelihood of an exacerbation of the situation via explosion and involvement of other combustibles.

b. The choice of self-contained breathing apparatus rather than line-supplied air is based on two factors: one is the restricted mobility of the latter, and the other is the question of the air hose resistance to such a variety of solvents through which it might have to be dragged.

c. An assumption is made that the SCBA and each type of canister will have built-in conforming face and eye protection. Therefore, in those cases where the use of a canister is recommended, the use of chemical goggles has not been indicated.

d. The absorbent in a canister has a limited absorption capacity. Therefore, refills should be at hand. It is also possible that the size of a spill or other conditions such as a spill in an enclosed area

will reduce the oxygen content of the air. In that case, an SCBA must be substituted for the canister.

3. Elastomer Compatibility with Different Hazardous Materials

Following the selection of personnel gear, it became necessary to specify, for each hazardous material, the type of elastomer that could be used in the coating of the body protective clothing, and in the gloves and boots. A number of references were consulted, and surprisingly, very significant differences were found among these as to the recommended elastomers. In several cases, various source recommendations varied from "excellent' to "poor" for the same chemical. It was finally decided to rely heavily on the recommendations of the chemical industry, augmented by other judgmental factors.

The six types of elastomer that were found to be most used were: neoprene, butyl rubber, EPA, Hypalon, butadiene and fluoroelastomers. In many cases it was found that more than one type of elastomer was suitable, and these were indicated on the work sheets; however, only one is listed in the final compilation. It should be pointed out that in several cases, the best elastomer available was listed nowhere better than "fair" in its resistance to the particular material.

4. Quantities of Equipment as a Function of Spill Size and Material

Finally, since spills of hazardous materials come in various sizes, it was necessary to determine how many units of personnel response gear should be available for different size spills of the same material. Here, again, some assumptions had to be made.

a. In most cases, if the spill was into a waterway, the methods of response would require the use of a different set of parameters than those used in this work. It was therefore assumed that the spill occurred either on land adjacent to a waterway or on board a vessel in a waterway.

b. The minimum gear recommended, no matter what the material spilled, nor the size of the spill, was two units. The reason for two units is principally the premise that any spill considered as a hazardous material should be approached by at least two individuals suitably prepared and clothed. A backup is always needed in the event of a

AD-A123 075 US COAST GUARD EQUIPMENT DEPLOYMENT REQUIREMENTS FOR HAZARDOUS CHEMICAL'S..(U) TRANSPORTATION SYSTEMS CENTER CAMBRIDGE MA RESEARCH AND SPECI.. J BELLANTONI ET AL. 3/3

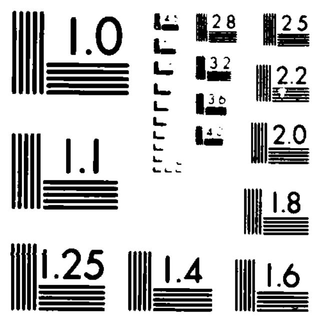
UNCLASSIFIED NOV 82 DOT-TSC-USCG-82-1 USCG-W-001-82 F/G 7/0 NL

END

DATE FILMED

2-83

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

mishap occurring to one. The maximum number of units of gear recommended up to the size limit of 30,000 gallons was four.

c. The quantities of equipment indicated are those for personnel in the immediate area of the spill, i.e., in the 'hot' zone. In most cases good practice dictates that there be an equal number of personnel, in the area surrounding the 'hot' zone, i.e., in the area of immediate danger to health atmosphere (IDHA). The quantities shown must be doubled to account for personnel in the IDHA zone.

d. In the case of the spill of a highly volatile material, the assumption was made that by the time of the arrival of the response team, a great deal of the spill will have evaporated. If the spill is a continuing one, as from a small puncture in a large tank, fewer individuals are required to approach the leak with plugs or off-loading equipment.

REFERENCES
TO APPENDIX C

1. USCG Commandant Instruction M16465.12 (OLD CG-446-2). Manual of the Chemical Hazardous Response Information System (CHRIS).
2. USCG Commandant Instruction 16465.16. Policy Guidance for Response to Hazardous Chemical Discharges.
3. Standard Transportation Commodity Code Tariff No. 1-G (STCC 49).
4. U.S. Coast Guard Pollution Incident Reporting System (PIRS) CG-450.
5. USCG Commandant Instruction M16465.14. CHRIS Response Methods Handbook.
6. USCG Survey of Personnel Protective Clothing and Respiratory Apparatus for use by Coast Guard Personnel in Response to Discharges of Hazardous Chemicals. W.M. Hammer et al (Sept. 1974).
7. The General Chemical Resistance of Various Elastomers - 1979 Yearbook of the Los Angeles Rubber Group, Inc.
8. Chemical Resistance of DuPont Elastomers - E.I. Dupont Co.
9. SAX, N.I. - Dangerous Properties of Industrial Materials. (Reinhold)
10. Kirk-Othmer-Encyclopedia of Chemical Technology.
11. Hammer, W.F. et al, "Survey of Protective Clothing and Respiratory Apparatus for Use by Coast Guard Personnel in Response to Discharge of Hazardous Chemicals," CG-D-89-75.
12. "Analysis of Hazardous Chemical Spills Along the Coasts and Major Waterways of the United States," U.S. Department of Transportation, Transportation Systems Center, Cambridge, MA, Report No. CG-123-1.
13. "Interim Report on Coast Guard Related Chemical Spill Data," Project Memorandum, CG 023, September 1980. Report No. CG-023-1, Transportation Systems Center, Cambridge, MA 02142.

APPENDIX C1

ESTIMATES OF PERSONNEL PROTECTION GEAR REQUIRED AS A FUNCTION OF SPILL SIZE

This Appendix lists, for each of 157 MTB-listed chemicals and 130 PIRS-listed chemicals, the types and quantities of protective gear estimated to be needed to respond to a spill of given size of the chemical.

The first two columns show the MTB or PIRS code for the chemical. (A description of the chemical is given in the last column.) The third column lists spill size (QTY) and the units (U) which are either gallons (G) or pounds (P). The next column (headed NU) gives the minimum number of units estimated to be required to respond to a spill size not exceeding that under QTY of the same line, but exceeding the amount on the preceding line. (The amount zero is understood for the first value of QTY of the chemical.) Spills of quantities greater than the largest listed for the chemical require the largest number of units shown in the NU column.

The types of gear are indicated in the column headed "Personnel Protection Gear Code." The codes are explained on p. 28. The number of units required applied to each type of gear for which there is an entry under "Personnel Protection Gear Code." The terminology 'rubber clothing', 'rubber gloves', 'rubber boots' are used generically to indicate items of the specific material following the hyphen.

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE / PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
0203175			A1 J6	CHLOROFORM
0203175	002000G	2		
0203175	005000G	2		
0203175	010000G	2		
0205186			A1 J1	FORMALDEHYDE FORMALIN SOLUTION 110 GAL OR LESS
0205186	001000G	2		
0205186	005000G	2		
0205186	010000G	3		
0205186	030000G	3		
1008294			A1 I1J2	ORGANIC PEROXIDE LIQUID OR SOLUTION N.O.S.
1008294	000500G	2		
1008294	002000G	3		
1008294	010000G	4		
2003475			C1 J1	COMBUSTIBLE LIQUID N.O.S.
2003475	002000G	2		
2003475	005000G	2		
2003475	050000G	3		
2003495			C1 J1	CLEANING LIQUID COMPOUND COMBUSTIBLE LIQUID
2003495	001000G	2		
2003495	005000G	2		
2003495	010000G	3		
2003495	025000G	4		
2003551			B1 K6L6	COMPOUND LACQUER/PAINT REMOVER COMBUSTIBLE LIQUID
2003551	001000G	2		
2003551	005000G	3		
2003551	010000G	4		
2005187			A1 J1	FORMALDEHYDE FORMALIN SOLUTION 110 GAL OR MORE
2005187	001000G	2		
2005187	005000G	2		
2005187	010000G	3		
2005187	030000G	3		
2005992			A1 J1	INSECTICIDE LIQUID N.O.S.
2005992	000500G	2		
2005992	002000G	2		
2005992	005000G	3		
2009031			C1 K3L3	RESIN SOLUTION COMBUSTIBLE LIQUID
2009031	001000G	2		
2009031	005000G	3		
2009031	010000G	4		
2008059			B1 K6L6	PAINT ENAMEL LACQUER OR STAIN COMBUSTIBLE LIQUID
2008059	001000G	2		
2008059	005000G	3		
2008059	010000G	4		
2008301			A1 K6L6	PETROLEUM DISTILLATE COMBUSTIBLE LIQUID
2008301	001000G	2		
2008301	005000G	2		
2008301	010000G	2		
2008301	025000G	3		

N.U. = Number of PPG units required @ ≥ QTY of the same line but < QTY of next line
U = Unit (G=gallon; P=pound)

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
20	08319			A1 K6L6	PETROLEUM NAPHTHA COMBUSTIBLE LIQUID
20	08319	001000G	2		
20	08319	005000G	2		
20	08319	010000G	3		
20	08319	025000G	4		
20	09719			B1 K6L6	SOLVENT N.O.S. COMBUSTIBLE
20	09719	001000G	2		
20	09719	005000G	3		
20	09719	010000G	4		
25	01010			A2 J2	ACETONE
25	01010	002000G	2		
25	01010	005000G	2		
25	01010	010000G	2		
25	01010	025000G	3		
25	01140			A1 J1	ACRYLONITRILE
25	01140	000500G	2		
25	01140	005000G	3		
25	01140	025000G	4		
25	01190			C1 K4	ALCOHOL N.O.S. FLAMMABLE LIQUID
25	01190	002000G	2		
25	01190	005000G	2		
25	01190	050000G	3		
25	01660			C1 K1L1	ANTIFREEZE COMPOUND FLAMMABLE LIQUID
25	01660	001000G	2		
25	01660	005000G	2		
25	01660	010000G	2		
25	01660	050000G	3		
25	02070			A1 J6	BENZENE (BENZOL)
25	02070	001000G	2		
25	02070	005000G	2		
25	02070	010000G	3		
25	02070	030000G	3		
25	02470			C1 K6L6	BUTYL ACETATE
25	02470	005000G	2		
25	02470	030000G	3		
25	02690			A1 J6	CARBON BISULFIDE OR CARBON DISULFIDE
25	02690	000250G	2		
25	02690	001000G	3		
25	02690	005000G	4		
25	02840			C1 J6	CEMENT LIQUID N.O.S.
25	02840	002000G	2		
25	02840	010000G	3		
25	02840	050000G	3		
25	02860			C1 K1L1	CEMENT ROOFING LIQUID
25	02860	002000G	2		
25	02860	010000G	3		
25	02860	050000G	3		

MTB CL-CODE PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE =A=B=C=D=E=F=G=H=I=J=K=L=M=N=O=	CHEMICAL DESCRIPTION
2502870			C1 J1	CEMENT RUBBER
2502870	002000G	2		
2502870	010000G	3		
2502870	050000G	3		
2503290			A1 H1	LIGHTER FLUID
2503290		0		
2503390			H1 I1 K6 L6	COATING SOLUTION
2503390	001000G	2		
2503390	005000G	2		
2503390	010000G	3		
2503500			C1 K1	CLEANING LIQUID COMPOUND
2503500	001000G	2		FLAMMABLE
2503500	005000G	3		
2503500	010000G	3		
2503500	050000G	4		
2503560			C1 J6	COMPOUND PAINT REMOVER
2503560	001000G	2		FLAMMABLE LIQUID
2503560	005000G	2		
2503560	010000G	3		
2503560	050000G	4		
2503590			C1 K1 L1	COMPOUND TREE/WEED KILLER
2503590	000500G	2		FLAMMABLE LIQUID
2503590	002000G	3		
2503590	005000G	3		
2503590	010000G	4		
2503900			A1 K3 L3	CYCLOHEXANE
2503900	001000G	2		
2503900	005000G	2		
2503900	010000G	3		
2503900	030000G	3		
2504450			N1	DRUGS CHEMICAL FLAMMABLE
2504450		0		
2504650			A1 K6 L6	ETHER
2504650		0		
2504660			C1 J2	ETHYL ACETATE
2504660	002000G	2		
2504660	010000G	2		
2504660	030000G	2		
2504661			A1 J2	ETHYL ACRYLATE INHIBITED
2504661	001000G	2		
2504661	005000G	2		
2504661	010000G	3		
2504661	030000G	3		
2504720			A1 J2	ETHYLENE DICHLORIDE
2504720	001000G	2		
2504720	005000G	2		
2504720	010000G	3		
2504720	025000G	3		
2504980			N1	EXTRACT LIQUID FLAVORING
2504980		0		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
2505130				A1									J6						FLAMMABLE LIQUIDS N.O.S.
2505130		001000G	2																
2505130		005000G	3																
2505130		010000G	3																
2505130		050000G	4																
2505360				A1										K1	L1				GASOLINE
2505360		001000G	2																
2505360		005000G	2																
2505360		010000G	3																
2505360		025000G	4																
2505580				A1										K1	L1				HEXANE
2505580		001000G	2																
2505580		005000G	2																
2505580		010000G	3																
2505580		030000G	4																
2505960										G1	H1		J1						INK
2505960		000150F	2																
2505960		001000F	2																
2505960		005000F	3																
2506000				A1									J1						INSECTICIDE FLAMMABLE
2506000		000500G	2																LIQUID N.O.S.
2506000		001000G	2																
2506000		005000G	3																
2506000		010000G	4																
2506080				A1										K1	L1				ISOPENTANE
2506080		001000G	2																
2506080		005000G	2																
2506080		010000G	3																
2506080		025000G	3																
2506924					B1								J1						METHYLAL
2506924		001000G	2																
2506924		005000G	2																
2506924		010000G	3																
2506924		050000G	4																
2507040				A1									J3						METHYL ETHYL KETONE
2507040		002000G	2																
2507040		005000G	2																
2507040		010000G	2																
2507040		025000G	3																
2507100				A1									J3						METHYL METHACRYLATE
2507100		001000G	2																MONOMER INHIBITED
2507100		005000G	2																
2507100		010000G	3																
2507100		025000G	3																
2507490				A1										K1	L1				MOTOR FUEL N.O.S.
2507490		001000G	2																FLAMMABLE LIQUID
2507490		005000G	2																
2507490		010000G	3																
2507490		025000G	4																

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	NU	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
2507520						C1							J1						NAPHTHA
2507520		001000G	2																
2507520		005000G	2																
2507520		010000G	3																
2507520		025000G	4																
2509030						C1							J3						RESIN SOLUTION
2509030		002000G	3																
2509030		010000G	3																
2509030		050000G	3																
2508060					B1									K6	L6				PAINT ENAMEL LAQUER OR
2508060		001000G	2																STAIN FLAMMABLE LIQUID
2508060		005000G	3																
2508060		010000G	3																
2508280				A1									J2						ORGANIC PEROXIDE LIQUID OR
2508280		000500G	2																SOLUTION-FLAMMABLE
2508280		002000G	3																
2508280		010000G	4																
2508300				A1										K1	L1				PETROLEUM DISTILLATE
2508300		001000G	2																FLAMMABLE LIQUID
2508300		005000G	2																
2508300		010000G	3																
2508300		025000G	4																
2508320				A1										K6					PETROLEUM NAPHTHA
2508320		001000G	2																
2508320		005000G	2																
2508320		010000G	3																
2508320		025000G	4																
2509720					B1									K6	L6				SOLVENTS N.O.S. FLAMMABLE
2509720		001000G	2																LIQUID
2509720		005000G	3																
2509720		010000G	4																
2508810				A1									J2						PYRIDINE
2508810		001000G	2																
2508810		005000G	2																
2508810		010000G	3																
2508810		030000G	3																
2509874				A1									J2						STYRENE MONOMER INHIBITED
2509874		001000G	2																
2509874		005000G	3																
2509874		010000G	3																
2509874		030000G	4																
2510184				A1									J2						TETRAHYDROFURAN
2510184		000250G	2																
2510184		001000G	2																
2510184		003000G	3																
2510184		005000G	3																
2510184		010000G	4																

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

NTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
2510340				A1 K6L6	TOLUENE OR TOLUOL
2510340		000500G	2		
2510340		005000G	3		
2510340		010000G	3		
2510340		025000G	4		
2510650				A1 J1	VINYL ACETATE
2510650		001000G	2		
2510650		005000G	2		
2510650		010000G	3		
2510650		025000G	3		
2510890				A1 K6L6	XYLENE (XYLOL)
2510890		002000G	2		
2510890		005000G	2		
2510890		010000G	3		
2510890		050000G	4		
3002535				G1 K1L1	CALCIUM CARBIDE
3002535		000500F	2		
3002535		002000F	2		
3002535		010000F	3		
3005140				A1 J6	FLAMMABLE SOLIDS N.O.S.
3005140		001000G	2		
3005140		005000G	3		
3005140		010000G	3		
3005140		050000G	4		
3008460				A1 J1 O1	PHOSPHORUS WHITE OR YELLOW WET
3008460		000250F	2		
3008460		001000F	3		
3008460		005000F	4		
3009570				G1H1I1J1	SODIUM HYDROSULFITE
3009570		001000F	2		
3009570		005000F	2		
3009570		010000F	3		
3009570		050000F	3		
3501340				G1 K1L1	AMMONIUM NITRATE NO ORGANIC COATING
3501340		001000F	2		
3501340		025000F	2		
3501350				G1 K1L1	AMMONIUM NITRATE FERTILIZE
3501350		005000F	2		
3501350		010000F	2		
3501350		025000F	3		
3502130				A1 J2	BENZOYL PEROXIDE
3502130		000500G	2		
3502130		002000G	3		
3502130		010000G	4		
3502560				F1 K2L2 O1	CALCIUM HYPOCHLORITE MIXTURE DRY .GT. 39% CHLORINE
3502560		000250F	2		
3502560		001000F	2		
3502560		005000F	2		
3502560		010000F	3		
3502560		030000F	3		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
3505851				A1 J4	HYDROGEN PEROXIDE 8-40%
3505851		002000G	2		
3505851		005000G	3		
3505851		010000G	3		
3505851		030000G	4		
3507701				A1 J3 O1	NITRIC ACID .GT. 40%
3507701		001000G	2		
3507701		005000G	3		
3507701		010000G	4		
3507702				A1 J4 O1	NITRIC ACID FUMING
3507702		001000G	2		
3507702		005000G	3		
3507702		010000G	4		
3508010				B1 J1	OXIDIZER OR OXIDIZING MATERIAL N.O.S.
3508010		002000F	2		
3508010		010000F	3		
3508010		050000F	4		
3509340				G1H1I1 K2L2	SILVER NITRATE
3509340			0		
3509630				G1 K3	SODIUM NITRATE
3509630		005000F	2		
3509630		010000F	2		
3509630		025000F	3		
3508650				G1H1I1 K1	POTASSIUM NITRATE
3508650		005000F	2		
3508650		010000F	2		
3508650		025000F	3		
4501620				A1 J1 O1	AMMONIA ANHYDROUS
4501620		000500G	2		
4501620		002000G	3		
4501620		005000G	4		
4502710				A1 J6	CARBON DIOXIDE LIQUEFIED
4502710		005000F	2		
4503140				A1 E1 J6 O1	CHLORINE
4503140		000100G	2		
4503140		000250G	3		
4503140		000500G	4		
4503660				N1	COMPRESSED NONFLAMMABLE GAS N.O.S.
4503660			0		
4505830				A1 J2 O1	HYDROGEN CHLORIDE
4505830		001000G	2		
4505830		005000G	3		
4505830		010000G	4		
4508040				H1I1 K6L6	OXYGEN PRESSURIZED LIQUID
4508040		000001G	2		
4509900				A1 J2	SULFUR DIOXIDE
4509900		000001G	2		
5002460				A1 J6	BUTADIENE INHIBITED
5002460		0050[illegible] 3	2		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE A-B-C-D-E-F-G-H-I-J-K-L-M-N-O	CHEMICAL DESCRIPTION
5003670			C1	COMPRESSED GAS FLAMMABLE N.O.S.
5003670		0		
5004710			C1 K2	ETHYLENE
5004710	000001G	2		
5005690			C1 K1	HYDROCARBON GAS NONLIQUEFIEI
5005690		0		
5005810			A1 J6	HYDROGEN
5005810	000001G	2		
5005860			A1 J1	HYDROGEN SULFIDE
5005860	000500G	2		
5005860	005000G	3		
5005860	010000G	3		
5006300			A1 H1	LIQUID PETROLEUM GAS
5006300		0		
5010480			C1 K1L1	TRIMETHYLAMINE ANHYDROUS
5010480	001000G	2		
5010480	010000G	2		
5010480	025000G	3		
6001640			C1 J2	ANILINE OIL LIQUID
6001640	001000G	2		
6001640	005000G	2		
6001640	010000G	2		
6001640	025000G	3		
6002670			A1 J2 O1	CARBOLIC ACID LIQUID
6002670	001000G	2		
6002670	005000G	3		
6002670	010000G	3		
6002670	030000G	4		
6002680			A1 J2 O1	CARBOLIC ACID SOLID
6002680	001000G	2		
6002680	005000G	3		
6002680	010000G	3		
6002680	030000G	4		
6003600			C1 K1L1	COMPOUND TREE/WEED KILLER POISON B. LIQUID
6003600	000500G	2		
6003600	002000G	3		
6003600	005000G	3		
6003600	010000G	4		
6003820			G1H1I1J1	CYANIDE OR MIXTURES
6003820	000250F	2		
6003820	001000F	3		
6003820	005000F	3		
6003820	010000F	4		
6003860			G1H1I1 K1L1	SODIUM CYANIDE SOLID
6003860	001000F	2		
6003860	005000F	3		
6003860	010000F	3		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
6004360				A1 J2	DINITROPHENOL SOLUTION
6004360		001000G	2		
6004360		005000G	2		
6004360		010000G	3		
6004360		025000G	3		
6005970				A1 J1	INSECTICIDE DRY
6005970		000500F	2		
6005970		002000F	2		
6005970		005000F	3		
6005980				A1 J1	INSECTICIDE POISONOUS LIQUID N.O.S.
6005980		000500G	2		
6005980		001000G	2		
6005980		005000G	3		
6005980		010000G	4		
6007480				A1 J2	MOTOR FUEL ANTIKNOCK COMPOUND
6007480		000500G	2		
6007480		002000G	3		
6007480		005000G	3		
6007480		010000G	4		
6007720				C1 J2	NITROBENZOL LIQUID
6007720		001000G	2		
6007720		005000G	2		
6007720		010000G	2		
6007720		030000G	3		
6007960				A1 J1	ORGANIC PHOSPHATE OR ORGANIC PHOSPHORUS COMP LIQUID
6007960		000500G	2		
6007960		001000G	3		
6007960		005000G	4		
6007965				A1 J1	ORGANIC PHOSPHATE/PHOSPHORC COMPOUND DRY/SOLID
6007965		000500G	2		
6007965		001000G	3		
6007965		005000G	4		
6007970				A1 J1	ORGANIC PHOSPHATE/ PHOSPHORUS COMPOUND MIX LIQUID
6007970		000500G	2		
6007970		001000G	3		
6007970		005000G	4		
6007980		000500F	2		
6007980				A1 J1	ORGANIC PHOSPHATE/ PHOSPHOROUS COMPOUND MIXTURE DRY
6007980		002000F	2		
6007980		005000F	3		
6008110				C1 J1	PARATHION LIQUID
6008110		000250G	2		
6008110		005000G	3		
6008110		020000G	3		
6008520				A1 J2	POISONOUS LIQUID CLASS B N.O.S.
6008520		000500G	2		
6008520		005000G	3		
6008520		010000G	4		
6008520		050000G	4		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE PIRS CODE	QTY U	N U	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
6008540					C1							J6						POISONOUS SOLID CLASS B
6008540	001000F	2																N.O.S.
6008540	005000F	2																
6008540	010000F	3																
6008540	050000F	3																
6010336					C1							J2						TOLUENE DIISOCYANATE
6010336	000500G	2																
6010336	005000G	3																
6010336	010000G	4																
9501004								F1				J1					O1	ACETIC AQUEOUS SOLUTION
9501004	001000F	2																
9501004	005000F	2																
9501004	010000F	3																
9501004	030000F	3																
9501006					C1							J4					O1	ACETIC ACID GLACIAL
9501006	001000G	2																
9501006	005000G	3																
9501006	020000G	4																
9501008			A1									J4					O1	ACETIC ANHYDRIDE
9501008	001000G	2																
9501008	005000G	3																
9501008	010000G	3																
9501008	020000G	3																
9501120			A1									J1					O1	ACID LIQUID N.O.S.
9501120	000500G	2																
9501120	005000G	3																
9501120	010000G	3																
9501120	050000G	4																
9501125										H1	I1	J1					O1	ACID SLUDGE
9501125	002000G	2																
9501125	005000G	3																
9501125	025000G	3																
9501132					C1							J1					O1	ACRYLIC ACID
9501132	001000G	2																
9501132	005000G	2																
9501132	010000G	3																
9501240			A1									J1					O1	ALKALINE LIQUID N.O.S.
9501240	001000G	2																
9501240	005000G	3																
9501240	010000G	4																
9501270				B1								J1						ALKALINE CORROSIVE LIQUID
9501270	002000G	2																N.O.S.
9501270	005000G	2																
9501270	010000G	3																
9501270	030000G	3																
9501336			A1									J1						AMMONIUM HYDROXIDE
9501336	002000G	2																.LT. 45% AMMONIA
9501336	005000G	2																
9501336	010000G	3																
9501336	050000G	4																

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
9501710				A1							H1		J1					O1	AQUEOUS AMMONIA
9501710		001000G	2																
9501710		005000G	3																
9501710		010000G	3																
9501710		020000G	3																
9502030											H1	I1	J4					O1	BATTERY ELECTRIC STORAGE WET
9502030			0																
9502120					B1								J6					O1	BENZOYL CHLORIDE
9502120		001000G	2																
9502120		005000G	2																
9502120		010000G	3																
9502260											H1	I1	J4					O1	BOILER COMPOUND LIQUID
9502260		002000G	2																
9502260		005000G	2																
9502260		010000G	3																
9502260		025000G	4																
9503180									F1				J1					O1	CHLOROSULFONIC ACID
9503180		000500G	2																
9503180		002000G	3																
9503180		005000G	3																
9503180		010000G	4																
9503270									F2				J4					O1	CHROMIC ACID SOLUTION
9503270		001000G	2																
9503270		005000G	3																
9503270		025000G	4																
9503354												I1		K1	L1				COAL TAR DYE LIQUID
9503354		002000G	2																
9503354		005000G	2																
9503354		010000G	2																
9503354		050000G	3																
9503490							D1						J1					O1	CLEANING LIQUID COMPOUND CORROSIVE
9503490		000500G	2																
9503490		001000G	2																
9503490		005000G	3																
9503490		010000G	4																
9503510									F1				J4					O1	COMPOUND CLEANING LIQUID WITH HYDROCHLORIC ACID
9503510		001000G	2																
9503510		005000G	3																
9503510		025000G	4																
9503540					B1									K6	L6			O1	COMPOUND RUST PREVENTOR OR REMOVER
9503540		001000G	2																
9503540		005000G	3																
9503540		010000G	4																
9503550					B1									K1	L1			O1	COMPOUND RUST PREVENTOR OR REMOVER CORROSIVE LIQUID
9503550		001000G	2																
9503550		005000G	3																
9503550		010000G	4																

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(3 DIFFERENT SPILL SIZES)

MTB PIRS CL-CODECODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
9503570			A1 J6 01	COMPOUND PAINT REMOVER CORROSIVE LIQUID
9503570	000500G	2		
9503570	002000G	3		
9503570	005000G	4		
9503570	010000G	4		
9503730			A1 J6 01	CORROSIVE LIQUID N.O.S.
9503730	000250G	2		
9503730	000500G	2		
9503730	001000G	3		
9503735			G1H1I1J1 01	CORROSIVE SOLID N.O.S.
9503735	001000F	2		
9503735	005000F	2		
9503735	010000F	3		
9503735	050000F	3		
9504480			H1I1 K1L1 01	DRUGS CHEMICALS CORROSIVE
9504480	002000G	2		
9504480	010000G	2		
9504480	025000G	3		
9504560			H1 J4 01	ELECTROLYTE BATTERY FLUID
9504560	000500G	2		
9504560	005000G	3		
9504560	010000G	3		
9504560	050000G	4		
9505005			G1H1I1J1 01	FERRIC CHLORIDE SOLUTION
9505005	005000F	2		
9505005	010000F	2		
9505005	030000F	2		
9505165			A1 J1 01	FLUOBORIC ACID
9505165	000250G	2		
9505165	000500G	2		
9505165	001000G	3		
9505190			A1 J2 01	FORMIC ACID
9505190	000250G	2		
9505190	001000G	2		
9505190	005000G	3		
9505570			A1 J1	HEXAMETHYLENE DIAMINE SOLUTION
9505570	000500G	2		
9505570	002000G	2		
9505570	005000G	3		
9505650			A1 J2	HYDRAZINE SOL .LT. 51 WT
9505650	000100G	2		
9505650	000500G	3		
9505650	001000G	4		
9505700			A1 J2 01	HYDROCHLORIC ACID
9505700	001000G	2		
9505700	005000G	3		
9505700	010000G	4		
9505700	025000G	4		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE (A-B-C-D-E-F-G-H-I-J-K-L-M-N-O)	CHEMICAL DESCRIPTION
9505770				A3 J4 O1	HYDROFLUORIC ACID SOLUTION
9505770		000200G	2		
9505770		000500G	3		
9505770		001000G	4		
9505800				F1 J1 O1	HYDROFLUOROSILICIC ACID
9505800		000250G	2		
9505800		000500G	2		
9505800		001000G	3		
9505870				F1 K2L2 O1	HYPOCHLORITE SOLUTION W/
9505870		002000G	2		.GT. 7% AVAILABLE CHLORINE
9505870		010000G	3		
9505870		030000G	4		
9507276				B1 J3 O1	MONOETHANOLAMINE
9507276		002000G	2		
9507276		005000G	3		
9507276		030000G	3		
9507700				A1 J3 O1	NITRIC ACID 40% OR LESS
9507700		001000G	2		
9507700		005000G	3		
9507700		010000G	4		
9507950				A1 J4 O1	OLEUM (SULFURIC ACID
9507950		000500G	2		FUMING)
9507950		001000G	2		
9507950		002000G	3		
9507950		010000G	4		
9508365				H1I1J4 O1	PHOSPHORIC ACID OR
9508365		002000G	2		PHOSPHORIC ACID SOLUTION
9508365		005000G	2		
9508365		010000G	3		
9508365		025000G	4		
9508400				A1 J2 O1	PHOSPHORUS OXYCHLORIDE
9508400		000250G	2		
9508400		000500G	2		
9508400		001000G	3		
9508400		010000G	4		
9508440				A1 J2 O1	PHOSPHRUS TRICHLORIDE
9508440		000250G	2		
9508440		002000G	3		
9508440		005000G	4		
9509574				G1H1I1J1 O1	SODIUM HYDROXIDE SOLID
9509574		000200F	2		FLAKE BEAD OR GRANULAR
9509574		005000F	2		
9509574		010000F	3		
9509574		025000F	3		
9509575				D1 J1 O1	SODIUM HYDROXIDE LIQUID
9509575		005000G	2		OR SOLUTION
9509575		010000G	2		
9509575		050000G	3		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL	CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
95	08628				H1I1J2 01	POTASSIUM HYDROXIDE LIQUID
95	08628		000200G	2		OR SOLUTION
95	08628		000500G	2		
95	08628		010000G	3		
95	08628		025000G	3		
95	09760				A1 I1J1 01	SULFURIC ACID SPENT
95	09760		001000G	2		
95	09760		005000G	2		
95	09760		010000G	3		
95	09760		020000G	3		
95	08766				A1 K1L1 01	PROPIONIC ACID
95	08766		001000F	2		
95	08766		005000F	2		
95	08766		025000F	3		
95	09930				A1 J1 01	SULFURIC ACID
95	09930		001000G	2		
95	09930		005000G	3		
95	09930		010000G	4		
95	09890				A1 J1 01	SULFURIC CHLORIDE
95	09890		000050G	2		
95	09890		000250G	3		
95	09890		001000G	4		
95	10230				A1 J6 01	THIONYL CHLORIDE
95	10230		000250G	2		
95	10230		000500G	2		
95	10230		001000G	3		
95	10230		005000G	4		
95	10290				A1 J2 01	TIN TETRACHLORIDE
95	10290		001000G	2		ANHYDROUS
95	10290		005000G	3		
95	10290		025000G	4		
95	10730				H1I1 K1L1 01	WATER TREATMENT COMPOUND
95	10730		002000G	2		LIQUID
95	10730		010000G	3		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	1010			A1 J1	NATURAL (CASINGHEAD) GASOLINE
	1010	0010000G	2		
	1010	0050000G	2		
	1010	0100000G	3		
	1010	0250000G	3		
	1011			A1 J1	GASOLINE (AVIATION OR AUTOMOTIVE)
	1011	0010000G	2		
	1011	0050000G	2		
	1011	0100000G	3		
	1011	0250000G	3		
	1030			A1 J1	NAPHTHA
	1030	0010000G	2		
	1030	0050000G	2		
	1030	0100000G	3		
	1030	0250000G	3		
	1031			A1 K6L6	MINERAL SPIRITS
	1031	0010000G	2		
	1031	0050000G	2		
	1031	0100000G	3		
	1031	0250000G	3		
	1032			A1 J1	OTHER PETROLUEM SOLVENT
	1032	0010000G	2		
	1032	0050000G	2		
	1032	0100000G	3		
	1032	0250000G	3		
	1070			N1	ANIMAL OIL
	1070		0		
	1071			N1	VEGETABLE
	1071		0		
	1091			I1 K1L1	HYDRAULIC FLUID
	1091	0050000G	2		
	1091	0300000G	2		
	1092			A1 K6L6M6	LACQUER-BASED PAINT
	1092	0010000G	2		
	1092	0050000G	3		
	1092	0100000G	3		
	1092	0250000G	3		
	1093			A1 I1 K1L1	PARAFFIN WAX
	1093		0		
	1096			B1 I1J1	OIL-BASED PESTICIDES
	1096	0005000G	2		
	1096	0050000G	3		
	1096	0100000G	3		
	1096	0250000G	4		
	2001			C1 J1	ACETALDEHYDE
	2001	0020000G	2		
	2001	0050000G	2		
	2001	0100000G	3		
	2001	0250000G	3		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY	NU	PERSONNEL PROTECTION GEAR CODE (A B C D E F G H I J K L M N O)	CHEMICAL DESCRIPTION
2002				A1 J4 O1	ACETIC ANHYDRIDE
2002		001000G	2		
2002		005000G	3		
2002		010000G	3		
2002		025000G	3		
2003				A1 J2	ACETONE
2003		002000G	2		
2003		005000G	2		
2003		010000G	2		
2003		025000G	3		
2004				A1 J2	ACETONE CYANOHYDRIN
2004		000250G	2		
2004		001000G	3		
2004		005000G	3		
2004		010000G	4		
2005				A1 K1L1	ACETONITRILE (METHYLCYANIDE)
2005		001000G	2		
2005		005000G	3		
2005		010000G	3		
2005		025000G	4		
2008				C1 J1 O1	ACRYLIC ACID
2008		001000G	2		
2008		002000G	2		
2008		025000G	3		
2009				A1 J1	ACRYLONITRILE
2009		000500G	2		
2009		005000G	3		
2009		025000G	4		
2010				A1 J1	ADIPONITRILE
2010		000500G	2		
2010		001000G	2		
2010		005000G	3		
2010		025000G	4		
2020				A1 J6 O1	BENZYL CHLORIDE
2020		000500G	2		
2020		001000G	2		
2020		005000G	3		
2020		025000G	4		
2011				C1 J1	ALLYL ALCOHOL
2011		001000G	2		
2011		005000G	2		
2011		010000G	3		
2011		025000G	3		
2013				A1 J1 O1	CADMIUM COMPOUNDS
2013		000500G	2		
2013		002000G	3		
2013		005000G	4		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	NU	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
	2014					C1							J6						CALCIUM COMPOUNDS
	2014	002000G	2																
	2014	010000G	2																
	2014	025000G	2																
	2015					C1							J2						n-AMYL ALCOHOL
	2015	002000G	2																
	2015	010000G	2																
	2015	025000G	2																
	2017					C1								K2	L2				ANILINE
	2017	000500G	2																
	2017	001000G	2																
	2017	005000G	3																
	2017	025000G	4																
	2018			A1									J1						CHLORINE
	2018	001000G	2																
	2018	005000G	2																
	2018	010000G	3																
	2018	030000G	3																
	2021				B1									K6	L6				n-BUTYL ACETATE
	2021	002000G	2																
	2021	010000G	2																
	2021	030000G	2																
	2022			A1									J6						n-BUTYL ACRYLATE
	2022	002000G	2																
	2022	005000G	2																
	2022	025000G	3																
	2023					C1						I1		K1	L1				n-BUTYL ALCOHOL
	2023	002000G	2																
	2023	005000G	2																
	2023	010000G	2																
	2023	030000G	3																
	2024										H1	I1		K1	L1				BUTYL ETHER
	2024	002000G	2																
	2024	010000G	2																
	2024	030000G	2																
	2025					C1							J2						n-BUTYRALDEHYDE
	2025	002000G	2																
	2025	005000G	2																
	2025	010000G	2																
	2025	030000G	3																
	2026			A1									J1					O1	BUTYRIC ACID
	2026	002000G	2																
	2026	005000G	3																
	2026	010000G	3																
	2027			A1									J6					O1	BROMINE
	2027	000100G	2																
	2027	000250G	3																
	2027	000500G	4																

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2029			C1 J6	CARBON TETRACHLORIDE
	2029	002000G	2		
	2029	005000G	2		
	2029	025000G	3		
	2030			G1H1I1J1 O1	CAUSTIC SODA
	2030	002000F	2		
	2030	005000F	2		
	2030	010000F	3		
	2030	025000F	3		
	2031			A1 J1	CHLOROFORM
	2031	001000G	2		
	2031	005000G	3		
	2031	010000G	4		
	2032			F1 J1 O1	CHLOROSULFONIC ACID
	2032	001000G	2		
	2032	005000G	3		
	2032	010000G	3		
	2032	025000G	4		
	2033			C1 H1 J1 C1	CRESOL
	2033	001000G	2		
	2033	005000G	3		
	2033	010000G	3		
	2033	030000G	4		
	2034			A1 J2	CROTONALDEHYDE
	2034	001000G	2		
	2034	005000G	2		
	2034	025000G	3		
	2035			C1 K3L3	CYCLO HEXANE
	2035	002000G	2		
	2035	005000G	2		
	2035	010000G	3		
	2035	025000G	3		
	2039			A1 J6	DICHLOROPROPANE-DICHLOROPROPANE MIXTURE (D.D. SOIL FUMIGANT)
	2039	002000G	2		
	2039	005000G	2		
	2039	010000G	3		
	2039	025000G	3		
	2040			A1 J1	DIETHANOLAMINE
	2040	002000G	2		
	2040	005000G	2		
	2040	025000G	2		
	2044			A1 J2	DIMETHYLAMINE (40% AQUEOUS)
	2044	002000G	2		
	2044	005000G	2		
	2044	010000G	2		
	2046			H1 K1L1	GLYCOL
	2046	005000G	2		
	2046	010000G	2		
	2046	025000G	2		

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2047			A1 J2	EPICHLOROHYDRIN
	2047	002000G	2		
	2047	005000G	3		
	2047	010000G	3		
	2047	020000G	3		
	2048			A1 J2	ETHYL ACETATE
	2048	002000G	2		
	2048	010000G	2		
	2048	025000G	3		
	2049			A1 J1	ETHYL ACRYLATE
	2049	002000G	2		
	2049	005000G	2		
	2049	025000G	3		
	2050			C1 K1L1	ETHYL ALCOHOL
	2050	002000G	2		
	2050	005000G	2		
	2050	010000G	2		
	2050	030000G	3		
	2051			A1 J1	ETHYLENE CYANOHYDRIN
	2051	002000G	2		
	2051	005000G	2		
	2051	010000G	3		
	2051	025000G	3		
	2052			J1	ETHYLENEDIAMINE
	2052	002000G	2		
	2052	005000G	2		
	2052	010000G	2		
	2052	025000G	3		
	2053			H1 K1L1	ETHYLENE GLYCOL
	2053	005000G	2		
	2053	010000G	2		
	2053	025000G	2		
	2055			A1 J1	FORMALDEHYDE
	2055	001000G	2		
	2055	005000G	2		
	2055	010000G	3		
	2055	025000G	3		
	2057			H1I1 K2L2	FURFURAL
	2057	001000G	2		
	2057	005000G	2		
	2057	010000G	2		
	2057	025000G	3		
	2058			H1 K1L1	GLYCERINE
	2058	010000G	2		
	2058	030000G	2		
	2059			A1 I1 K4L4	n-HEXANE
	2059	001000G	2		
	2059	005000G	2		
	2059	010000G	3		
	2059	025000G	4		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2060			A1 J1 O1	HYDROCHLORIC ACID
	2060	001000G	2		
	2060	005000G	2		
	2060	010000G	3		
	2060	025000G	4		
	2061			A1 J4 O1	HYDROFLUORIC ACID (40% AQUEOUS)
	2061	000150G	2		
	2061	000500G	3		
	2061	001000G	4		
	2062			A1 J1	HYDROGEN PEROXIDE (.GT. 60%)
	2062	002000G	2		
	2062	005000G	3		
	2062	010000G	3		
	2062	025000G	4		
	2063			A1 K1L1M1	ISOPRENE
	2063	002000G	2		
	2063	005000G	2		
	2063	025000G	3		
	2064			C1 K2L2	ISOPROPYL ALCOHOL
	2064	002000G	2		
	2064	005000G	2		
	2064	010000G	2		
	2064	030000G	3		
	2065			B1 J1	LIQUID SULFUR
	2065	005000F	2		
	2065	025000F	2		
	2066			C1 K1L1	METHYL ACRYLATE
	2066	001000G	2		
	2066	005000G	2		
	2066	010000G	3		
	2066	025000G	3		
	2067			C1 K1L1	METHYL ALCOHOL
	2067	002000G	2		
	2067	005000G	2		
	2067	010000G	2		
	2067	030000G	3		
	2069			A1 J3	METHYL ETHYL KETONE (2-BUTANONE)
	2069	002000G	2		
	2069	005000G	2		
	2069	010000G	2		
	2069	025000G	3		
	2070			C1 J1	METHYL ISO-BUTYL KETONE
	2070	002000G	2		
	2070	005000G	2		
	2070	010000G	2		
	2070	025000G	3		

NTB CL-CODE	PIRS CODE	QTY U	N U	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
	2071					C1							J6						METHYLENE CHLORIDE
	2071	002000G	2																
	2071	005000G	2																
	2071	010000G	3																
	2071	025000G	3																
	2072			A1									J6						METHYL METHACRYLATE
	2072	002000G	2																
	2072	005000G	2																
	2072	025000G	3																
	2074					C1								K1	L1				MORPHOLINE
	2074	002000G	2																
	2074	005000G	2																
	2074	010000G	3																
	2074	025000G	3																
	2075			A1									J3					O1	NITRIC ACID
	2075	001000G	2																
	2075	005000G	3																
	2075	010000G	4																
	2077										H1			K1	L1				n-OCTANOL
	2077	002000G	2																
	2077	005000G	2																
	2077	010000G	2																
	2077	025000G	3																
	2078			A1									J6					O1	OLEUM
	2078	000500G	2																
	2078	001000G	2																
	2078	002000G	3																
	2078	010000G	4																
	2079					C1								K6	L6				PERCHLOROETHYLENE (TETRACHLOROETHYLENE)
	2079	002000G	2																
	2079	010000G	2																
	2079	025000G	2																
	2080			A1								I1	J2						PHENOL
	2080	001000G	2																
	2080	005000G	3																
	2080	010000G	3																
	2080	030000G	4																
	2082										H1	I1	J4					O1	PHOSPHORIC
	2082	002000G	2																
	2082	005000G	2																
	2082	010000G	3																
	2082	025000G	4																
	2083					C1						I1		K1	L1				n-PROPYL ALCOHOL
	2083	002000G	2																
	2083	005000G	2																
	2083	010000G	2																
	2083	025000G	3																

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY	U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2085				A1 K2L2	PROPYLENE OXIDE
	2085	005000	G	2		
	2085	010000	G	2		
	2085	025000	G	3		
	2095	025000	G	2		
	2086				A1 J2	STYRENE
	2086	001000	G	2		
	2086	005000	G	3		
	2086	010000	G	3		
	2086	030000	G	4		
	2087				A1 O1	SULFURIC ACID
	2087	001000	G	2		
	2087	005000	G	2		
	2087	010000	G	3		
	2087	025000	G	3		
	2088				A1 J1	TETRATHYL LEAD
	2088	000500	G	2		
	2088	002000	G	3		
	2088	005000	G	3		
	2088	010000	G	4		
	2089				A1 J1	TOLUENE
	2089	001000	G	2		
	2089	005000	G	2		
	2089	010000	G	3		
	2089	030000	G	3		
	2090				C1 J6	TRICHLOROETHANE
	2090	000500	G	2		
	2090	005000	G	2		
	2090	010000	G	3		
	2090	025000	G	3		
	2093				C1 K6L6	TURPENTINE
	2093	005000	G	2		
	2093	010000	G	2		
	2093	025000	G	3		
	2094				C1 J1	VINYL ACETATE
	2094	002000	G	2		
	2094	005000	G	2		
	2094	020000	G	2		
	2095				C1 J2	VINYLIDENE CHLORIDE
	2095	002000	G	2		
	2095	005000	G	2		
	2095	010000	G	2		
	2096				A1 K6L6M6	XYLENE
	2096	001000	G	2		
	2096	005000	G	3		
	2096	010000	G	3		
	2096	025000	G	3		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	CHEMICAL DESCRIPTION
	2101								F1				J1					O1	ACETIC ACID
	2101	001000G	2																
	2101	005000G	2																
	2101	010000G	3																
	2101	025000G	3																
	2103									G1		I1		K1	L1				ALUMINUM SULFATE (ALUM)
	2103	005000F	2																
	2103	030000F	2																
	2104			A1								I1	J1						AMMONIUM COMPOUNDS
	2104	002000F	2																
	2104	005000F	2																
	2104	010000F	2																
	2104	030000F	2																
	2105			A1									J1						ANTIMONY COMPOUNDS
	2105	000500F	2																
	2105	002000F	3																
	2105	010000F	3																
	2105	030000F	4																
	2112			A1									J3						BUTYLAMINE
	2112	000500G	2																
	2112	002000G	2																
	2112	005000G	3																
	2112	010000G	3																
	2112	030000G	4																
	2114				B1							I1	J1						CALCIUM COMPOUNDS
	2114	002000F	2																
	2114	005000F	2																
	2114	010000F	2																
	2114	030000F	2																
	2117					C1						I1	J1						CHLORDANE
	2117	000250F	2																
	2117	001000F	3																
	2117	005000F	3																
	2117	010000F	4																
	2118			A1									J2					O1	CHLORINE
	2118	000100G	2																
	2118	000250G	3																
	2118	000500G	4																
	2120				B1								J2					O1	CHROMIUM COMPOUNDS
	2120	002000F	2																
	2120	030000F	3																
	2122			A1									J1						COPPER COMPOUNDS
	2122	002000F	2																
	2122	005000F	2																
	2122	010000F	2																
	2122	030000F	2																

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2124			A1 H1 J1	CYANIDE COMPOUNDS
	2124	000500F	2		
	2124	002000F	3		
	2124	010000F	3		
	2124	030000F	4		
	2125			G1H1 K1L1	2,4-D (ACID)
	2125	001000F	2		
	2125	005000F	3		
	2125	010000F	3		
	2125	025000F	4		
	2136			A1 J1	DINITROPHENOL
	2136	001000F	2		
	2136	005000F	3		
	2136	010000F	3		
	2136	025000F	4		
	2145			A1 K2L2	ETHYLBENZENE
	2145	002000G	2		
	2145	005000G	2		
	2145	010000G	2		
	2145	030000G	3		
	2146			A1 J1 O1	FLUORINE COMPOUNDS
	2146	000500F	2		
	2146	002000F	3		
	2146	010000F	3		
	2146	030000F	4		
	2151			G1 I1 K1L1	IRON COMPOUNDS
	2151	002000F	2		
	2151	005000F	2		
	2151	010000F	2		
	2151	030000F	3		
	2153			B1 J1	LEAD COMPOUNDS
	2153	002000F	2		
	2153	005000F	2		
	2153	010000F	2		
	2153	030000F	3		
	2156			G1 I1 K1L1	MALEIC ACID
	2156	005000F	2		
	2156	010000F	2		
	2156	025000F	2		
	2158			G1 I1 K1L1 O1	MERCURY COMPOUNDS
	2158	000500F	2		
	2158	002000F	3		
	2158	010000F	3		
	2158	030000F	4		
	2161			C1 J2	METHYL PARATHION
	2161	000250F	2		
	2161	001000F	3		
	2161	005000F	4		

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY	U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2165				C1 J6	NAPHTHALENE
	2165	002000	G	2		
	2165	005000	G	2		
	2165	010000	G	2		
	2165	025000	G	3		
	2169				A1 J2 O1	NITROGEN DIOXIDE
	2169	000150	G	2		
	2169	001000	G	3		
	2169	005000	G	4		
	2180	005000	F	2		
	2172				C1 J1	PARATHION
	2172	000100	G	2		
	2172	000500	G	2		
	2172	001000	G	3		
	2172	005000	G	4		
	2173				H1I1 K1L1	PCB's
	2173	000100	G	2		
	2173	000250	G	3		
	2173	001000	G	4		
	2174				G1 I1J6	PENTACHLOROPHENOL
	2174	000250	F	2		
	2174	001000	F	2		
	2174	005000	F	3		
	2174	025000	F	4		
	2175				A1 J2	PHOSGENE
	2175	000150	G	2		
	2175	000500	G	3		
	2175	001000	G	4		
	2178				A1 J2 O1	PHOSPHORUS TRICHLORIDE
	2178	000250	F	2		
	2178	001000	F	3		
	2178	005000	F	4		
	2180				H1I1 K1	POTASSIUM PERMANGANATE
	2180	001000	F	2		
	2180	010000	F	2		
	2181				A1 J1	PROPIONIC ACID
	2181	000250	F	2		
	2181	001000	F	3		
	2181	005000	F	4		
	2188				G1 I1 K1L1	SODIUM BISULFITE
	2188	005000	F	2		
	2188	025000	F	2		
	2189				A1 J1 O1	SODIUM HYDROSULFIDE
	2189	001000	G	2		
	2189	005000	G	3		
	2189	010000	G	3		
	2189	025000	G	3		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	2190			A1 J2	SODIUM HYDROXIDE
	2190	002000G	2		
	2190	005000G	3		
	2190	010000G	3		
	2190	030000G	4		
	2191			H1 K1L1	SODIUM HYPOCHLORITE
	2191	001000G	2		
	2191	005000G	3		
	2191	010000G	3		
	2191	025000G	3		
	2193			G1 I1 K1L1	SODIUM NITRITE
	2193	005000F	2		
	2193	025000F	2		
	2195			G1H1 J2	SODIUM PHOSPHATE, MONOBASIC
	2195	005000F	2		
	2195	025000F	2		
	2197			G1H1 K1L1 O1	SODIUM SULFIDE
	2197	005000F	2		
	2197	025000F	2		
	2198			G1H1 K1L1	STRYCHNINE
	2198	000050F	2		
	2198	000200F	2		
	2198	000500F	2		
	2199			A1 J4 O1	SULFUR MONOCHLORIDE
	2199	001000G	2		
	2199	005000G	3		
	2199	010[illegible]0G	3		
	2204			C1 K2L2	TOXAPHENE
	2204	000050F	2		
	2204	000250F	3		
	2204	001000F	4		
	2209			G1H1 K1L1	URANIUM COMPOUNDS
	2209	000200F	2		
	2209	001000F	3		
	2209	005000F	3		
	2209	010000F	4		
	2211			A1 J2	XYLENOL
	2211	001000G	2		
	2211	005000G	2		
	2211	010000G	3		
	2211	025000G	3		
	2213			A1 J1 O1	ZINC COMPOUNDS
	2213	002000F	2		
	2213	005000F	2		
	2213	010000F	2		
	2213	030000F	3		

USCG HAZARDOUS CHEMICAL SPILLS RESPONSE

PERSONNEL PROTECTION GEARS
REQUIREMENTS
(@ DIFFERENT SPILL SIZES)

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION
	7008			A1 I1J1 O1	CHEMICAL WASTES
	7008	001000G	2		
	7008	005000G	2		
	7008	010000G	2		
	7008	025000G	3		
	7016			A1 I1J1 O1	INDUSTRIAL WASTES
	7016	001000G	2		
	7016	005000G	2		
	7016	010000G	2		
	7016	025000G	3		
	2091			A1 K6L6	TRICHLOROETHYLENE
	2091	000500 G	2		
	2091	005000 G	3		
	2091	010000 G	3		
	2091	025000 G	4		

MTB CL-CODE	PIRS CODE	QTY U	N U	PERSONNEL PROTECTION GEAR CODE -A-B-C-D-E-F-G-H-I-J-K-L-M-N-O-	CHEMICAL DESCRIPTION

NOTES :

COL 23 -- G = GALLONS ;
P = POUNDS

EQUIPMENTS CODES :

A1 = SCBA
A2 = SCBA - FOR HIGH CONCENTRATION
A3 = SCBA - PLASTIC LENS

B1 = CANISTER - ALL PURPOSE

C1 = CANISTER - ORGANIC

D1 = CANISTER - AMMONIA (ALKALI)

E1 = CANISTER - CHLORINE

F1 = CANISTER - ACID
F2 = CANISTER - ACID- CHROMIC AC FILT.

G1 = DUST MASK

H1 = CHEMICAL GOGGLES

I1 = FACE SHIELD

J1 = ALL RUBBER CLOTHING - NEOPRENE
J2 = ALL RUBBER CLOTHING - BUTYL RUBBER
J3 = ALL RUBBER CLOTHING - EPR
J4 = ALL RUBBER CLOTHING - HYPALON
J5 = ALL RUBBER CLOTHING - BUTADIENE
J6 = ALL RUBBER CLOTHING - FLUORO-ELASTOMER

K1 = RUBBER GLOVES - NEOPRENE
K2 = RUBBER GLOVES - BUTYL RUBBER
K3 = RUBBER GLOVES - EPR
K4 = RUBBER GLOVES - HYPALON
K5 = RUBBER GLOVES - BUTADIENE
K6 = RUBBER GLOVES - FLUORO-ELASTOMER

L1 = RUBBER BOOTS - NEOPRENE
L2 = RUBBER BOOTS - BUTYL RUBBER
L3 = RUBBER BOOTS - EPR
L4 = RUBBER BOOTS - HYPALON
L5 = RUBBER BOOTS - BUTADIENE
L6 = RUBBER BOOTS - FLUORO-ELASTOMER

M1 = HOOD

N1 = NO SPECIAL PROTECTION

O1 = CORROSIVE

100 copies

ED

3